GEER 2017

Greater Everglades Ecosystem Restoration

Advancing Science, Restoring the Everglades

April 17–20, 2017 • Coral Springs, FL

Program & Abstract Book

USGS science for a changing world
National Park Service
South Florida Water Management District
U.S. Fish & Wildlife Service
UF IFAS University of Florida

GEER 2017

Greater Everglades Ecosystem Restoration

Advancing Science, Restoring the Everglades

April 17–20, 2017 • Coral Springs, FL

MEETING LOCATOR

Registration & A/V Download
Grand Floridian Foyer

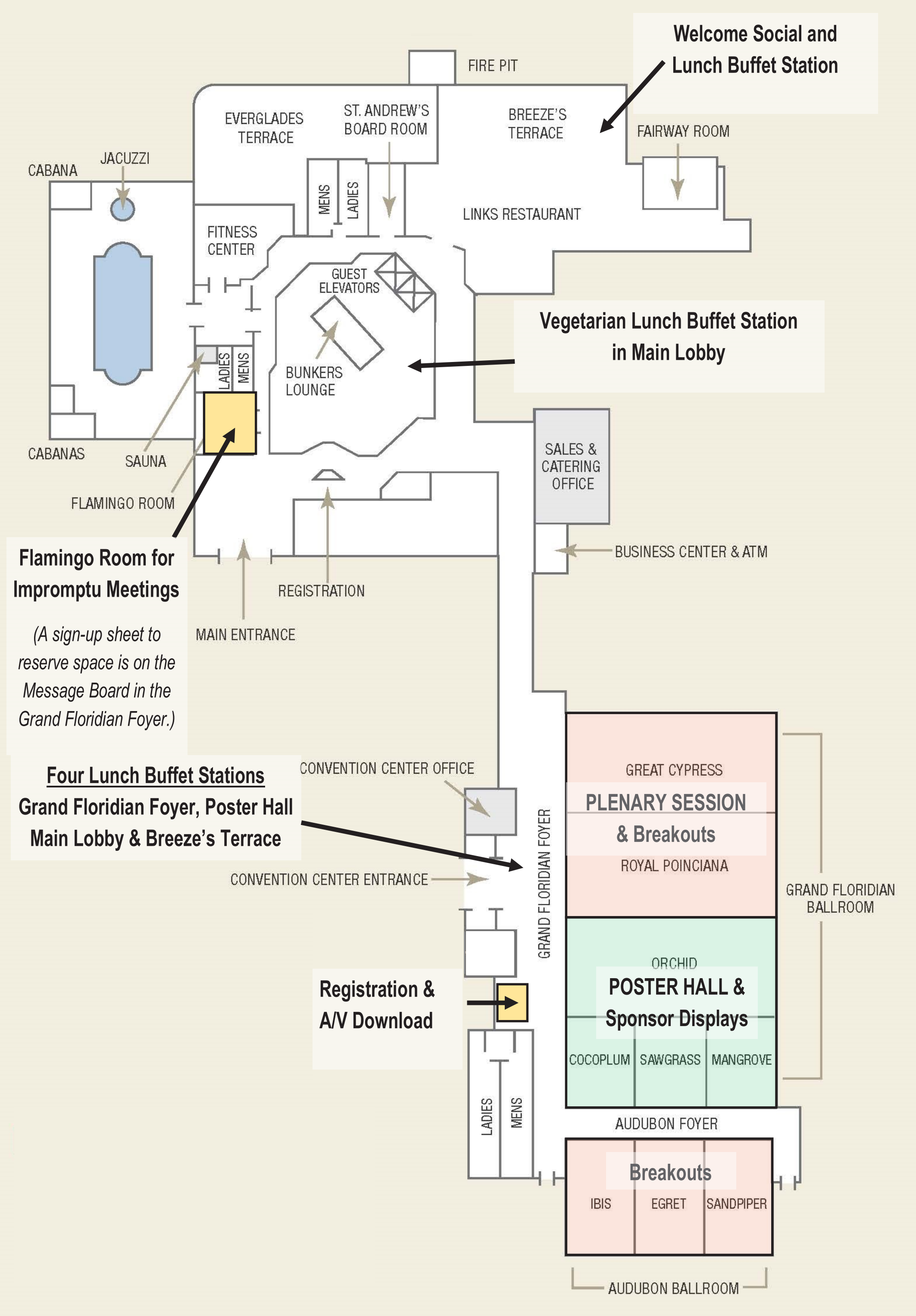
Plenary Session
Great Cypress &
Royal Poinciana

Breakout Sessions
Great Cypress
Royal Poinciana
Ibis
Egret
Sandpiper

Posters, Sponsor Displays & Refreshments
Orchid, Cocoplum,
Sawgrass & Mangrove

Lunch Buffet Locations
Poster Hall
Ballroom Foyer
Breeze's Terrace
Main Lobby *(vegetarian station)*

Impromptu Meetings
Flamingo Room



UF | IFAS
UNIVERSITY *of* FLORIDA

GEER 2017

Greater Everglades Ecosystem Restoration

Advancing Science, Restoring the Everglades

April 17-20, 2017

Coral Springs, Florida, USA

www.conference.ifas.ufl.edu/GEER2017

Join Us on Social Media!

Follow us on Twitter @GEER_Conference and like us on Facebook @GEERConference to see our posts. Use the hashtag #geerconference to stay connected with your fellow conference attendees.

About GEER

GREATER EVERGLADES SCIENCE continues to be a foundational element for Everglades restoration and management. Building on the successful GEER conferences in 2015 and before, GEER 2017 will address the most pressing and complex science issues that we face now and will face in the future of restoration – a future that includes climate change, threats from invasive species, altered hydrology, development pressure, and degraded water quality. High-quality science has supported new restoration projects that are underway, or soon to be underway, including: assessment of how a degraded Everglades will respond to restored sheet flow; how a record-breaking El Niño event provided us with climate and hydrology conditions not seen for decades – establishing new bookends in our data records; how we should deal with invasive species, both those recently introduced and those long-established; and the ongoing balance between restoration goals and endangered species protection. Sound science relevant to these challenges and the restoration efforts is required to provide resource managers and policy-makers with the best information possible. GEER 2017 will continue its legacy of providing a valuable forum for scientists and engineers to showcase and communicate the latest scientific developments and to facilitate information exchange that builds shared understanding among federal, state, local, and tribal scientists and decision-makers, academia, non-governmental organizations, the private sector, and private citizens.

The conference organizers have worked hard to provide an excellent location and conference venue, cutting-edge plenary and contributed sessions, and opportunities for valuable interaction – all while minimizing travel, lodging, and meeting costs.

Thank you for joining us and participating in GEER 2017's dialogue to better understand and inform Everglades restoration!

TABLE OF CONTENTS

This institution is an equal opportunity provider.

GEER 2017

Welcome to GEER 2017, the Greater Everglades Ecosystem Restoration (GEER) Science Conference – Advancing Science, Restoring the Everglades

We are thrilled to return to the Marriott – Fort Lauderdale and Coral Springs for the next iteration of our biennial GEER science conference. This venue has proven to be a pleasant, convenient, and affordable location for GEER, encouraging wide participation from the south Florida and national Everglades science community.

“Advancing Science, Restoring the Everglades” is our conference theme and GEER 2017 showcases the science behind recent advances in restoration, along with significant challenges we face to achieving our restoration vision: altered hydrology, degraded water quality, invasions by non-native plants and animals, human development placing pressure on our remaining natural systems, and climate change.

Despite these hurdles, major restoration progress has been achieved since our last conference in 2015. The Central Everglades Planning Project was authorized by Congress; SFWMD’s Restoration Strategies is ahead of schedule, including the completion of the A1 Reservoir; ground was broken for Tamiami Trail Modifications – Next Steps; the Florida legislature passed the Legacy Florida Bill which will provide a dedicated funding source of up to $200M per year for the next 10 years for Everglades restoration; in 2016, and for the eighth consecutive year, Florida received the country’s largest allocation from USDA for the Agricultural Conservation Easement Program; and during the 2016 El Niño event, water managers were able to use new infrastructure to move record amounts of water into Everglades National Park.

High-quality science relevant to these challenges and restoration efforts is required to provide resource managers and policy-makers with the best information possible. GEER 2017 provides a valuable forum to do just that, bringing together scientists, engineers, managers, and regulators to showcase and communicate the latest scientific developments, and to facilitate information exchange that builds shared understanding among federal, state, local, and tribal scientists, as well as decision-makers, academia, nongovernmental organizations, the private sector, and private citizens.

Initiated by the University of Florida-IFAS and the U.S. Geological Survey, GEER has become the preeminent Everglades science conference. GEER 2017 presents a full program over three days, in addition to two pre-conference workshops. The agenda features two plenary sessions and a closing keynote, five concurrent sessions of oral presentations, and two poster sessions – one in the evening of the first day in conjunction with a networking reception and one in the morning of the final day. Combined, these sessions address all aspects of Everglades science, representing many disciplines and sectors.

The 90-minute plenary sessions are in the mornings of the first two days. The first plenary is entitled "Bridging Science to Management in Large-scale Ecosystem Restoration Programs". The second plenary is a series of Ted-style presentations by six speakers who will deliver thoughtful and possibly provocative Everglades-focused and science centric talks on the topic of "Design, Innovation, and Governance (DIG): Solutions for Everglades Restoration." The conference concludes Thursday evening with a networking reception and a closing keynote address and book signing by Michael Grunwald, a best-selling author, a senior writer for *Politico Magazine*, and the Editor-at-Large of POLITICO's new public policy site, *The Agenda*. Be sure to stay until the end. You won't want to miss this presentation.

We wish to thank the members of the Program Committee who spent considerable time developing the GEER scientific program, seeking individuals to coordinate dedicated sessions, organizing individually submitted abstracts, and providing overall guidance to the conference.

We also would like to express our deepest appreciation to all of our conference sponsors. Without their support, it would be impossible to have a conference of this caliber. Please join me in thanking our Premier Sponsors, the National Park Service, the South Florida Water Management District, the U.S. Fish & Wildlife Service and the U.S. Geological Survey; our Supporting Sponsors, AECOM, DHI Water & Environment, Ecology and Environment, Inc., Eureka Water Probes, the Everglades Foundation, Florida Atlantic University's Center for Environmental Studies, Florida International University's Southeast Environmental Research Center, the Miccosukee Tribe of Indians of Florida, National Audubon Society, NorthStar, OTT Hydromet, Stanley Consultants, the University of Florida's Institute for Food and Agricultural Science, and YSI a xylem brand; and our Contributing Sponsor, ECO (Environment Coastal & Offshore) Magazine.

Last, but not least, we would like to thank Beth Miller-Tipton, Director of the University of Florida/IFAS Office of Conferences & Institutes (OCI), for organizing this year's GEER Conference, as in all previous years going back to 2000 and the first GEER in Naples, FL. In addition to Beth's hard work, Kyle Pitman designed our web graphics and printed materials, Kim Brand served as registrar, Kristin Zupancic, Tamar Ditzian and Jasmine Garcia assisted with agenda development and helped finalize our program and abstract publications while Lisa Pennington monitored our finances. GEER is a true team effort, and the exceptional quality of OCI's work is why this conference is a much-anticipated and valuable feature in south Florida's science community.

We trust you will take advantage of every opportunity GEER 2017 provides to view posters, visit with exhibiting sponsors, attend program sessions, and make new connections. As Conference Co-Chairs and on behalf of the Program Committee and the Executive Committee, we welcome you to GEER 2017. We're glad you could join us!

Sincerely,

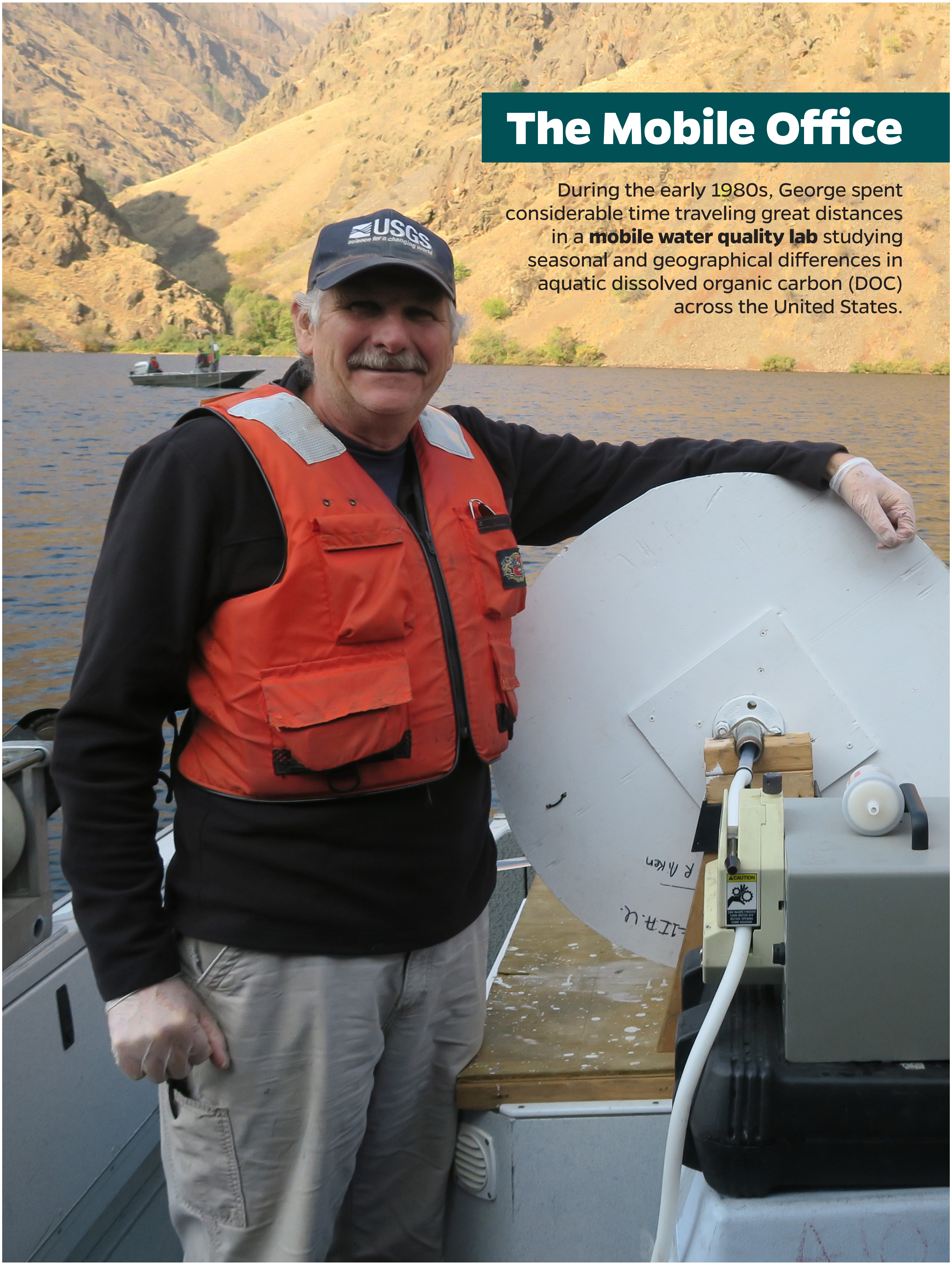
Nick Aumen
Regional Science Advisor - South Florida
Center for Collaborative Research
U.S. Geological Survey

K. Ramesh Reddy
Graduate Research Professor and Department Chair
Soil and Water Science Department
University of Florida/IFAS

This year's meeting is dedicated to **George Aiken** and **John Marshall** for their many contributions to the Greater Everglades, and for their dedication to GEER, attending every conference since its inception.

The Mobile Office

During the early 1980s, George spent considerable time traveling great distances in a **mobile water quality lab** studying seasonal and geographical differences in aquatic dissolved organic carbon (DOC) across the United States.



George R. Aiken

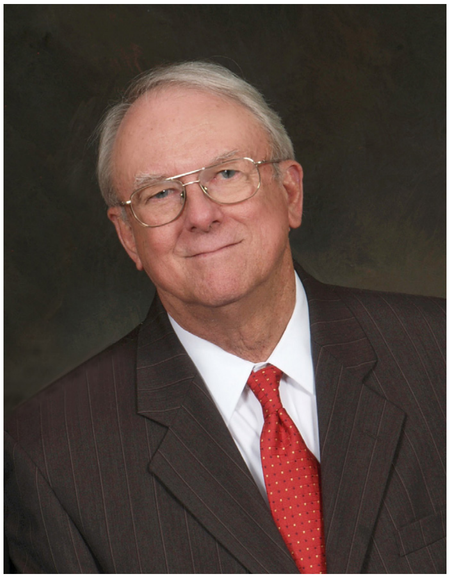
AUGUST 5, 1951 – DECEMBER 7, 2016

Everglades scientist and long-time U.S. Geological Survey (USGS) researcher Dr. George R. Aiken passed away on December 7, 2016. George spent his entire forty-year professional career as a research scientist with the USGS, located in Denver and Boulder, Colorado. Over that time period, George became prominently recognized nationally and internationally for his contributions to the field of biogeochemistry, with particular emphasis on the controlling influence that natural organic matter has on key chemical processes in ecosystems, including the Greater Everglades ecosystem that he dearly loved.

George joined the USGS in March 1976 with the Central Region of the USGS National Research Program (NRP) in Denver, Colorado. Before joining USGS, George earned a B.A. degree in Chemistry from Rutgers University. From 1976 to 1979, George worked with NRP's Organic Hydrogeochemistry Project, and it was then that he first encountered what would become the focus of his forty-year research career: unraveling the complexities of the importance of natural organic matter on controlling aqueous biogeochemistry of groundwater and surface water systems. Early in his research career, George focused on the design of new chromatographic techniques for isolating humic substances from natural waters, the movement of organic solutes in groundwater, and the effects of humic substances on water purification systems. Also during this time, George completed a M.S. in Analytical Chemistry at the University of Colorado.

During the 1980s, George spent considerable time traveling great distances in a mobile water quality lab studying seasonal and geographical differences in aquatic dissolved organic carbon (DOC) across the United States. It was during this time that he also garnered an encyclopedic understanding of the streams, watersheds and landscapes of the United States. For those fortunate to have a chance discussion with George, he called upon those experiences to help others understand the factors controlling surface water quality across the US. George also took several tours to Antarctica, where he studied DOC in lakes and streams, one of which bears his name. Typical of his dedication and love of his work, George over-wintered twice in Antarctica to ensure he would be able to study the full range of conditions in the harshest environment on the planet. In 1991, he achieved a lifetime goal by receiving a Ph.D. in Applied Chemistry (Minor in Geologic Engineering) from the Colorado School of Mines.

The USGS initiated the Aquatic Cycling of Mercury in the Everglades project in 1995, and George was among a select few scientists asked to join a multi-disciplinary research team focused on understanding the causes for elevated levels of mercury in the aquatic food web of the Everglades. At that time, the global mercury research community broadly noted that mercury and DOC usually positively correlated, and that DOC had something to do with the key process known as mercury methylation. Providing a much more mechanistic and fundamentally based understanding of the role DOC played mercury cycling became a central focus of George's career from that point forward, both in the Everglades and across the globe. He gave countless well-received presentations, including one at every GEER meeting, where he impressed upon the audience that "the yellowish color of the water inherent of the Everglades is like hemoglobin to our blood." He was among the first researchers anywhere to recognize that the methylation process was inextricably linked to the presence of DOC. But, as George would often humor his GEER audiences and remark, **"The Everglades is like a giant teabag. The DOC that leaches from that bag can be like Red Zinger or Sleepy time. Sometimes it can greatly increase mercury methylation, and sometimes not, depending more on the quality of the DOC than the quantity, which is not unlike a fine wine or beer."**



John Arthur Marshall

MAY 9, 1940 – MARCH 28, 2016

Everglades scientists, along with the entire south Florida restoration community, were very saddened to learn about the passing of John Marshall on March 28, 2016. John was passionate, knowledgeable and proud, and he was a long-time supporter of good science. He attended every single GEER conference, and we can be sure he would have been at GEER 2017. In addition to his own attendance, John always brought along a contingent of student interns, and encouraged their participation in the conference. An impressive cadre of bright, energetic individuals now beginning their promising careers owe their Everglades introduction to John and will always treasure his mentorship.

The long-time patriot, gator fan, and environmentalist was known and respected throughout the country as a trusted colleague, true friend, humanitarian, devoted husband, step-father, uncle and a nemesis to those who did not support his commitment to preserving the environment!

John Marshall founded the Florida Environmental Institute and the Arthur R. Marshall Foundation in 1998. The foundation was created to continue the work of his uncle, Arthur R. Marshall, renowned environmentalist and namesake of the Arthur R. Marshall Loxahatchee National Wildlife Refuge. This refuge is only one of twelve refuges in the United States named after a person. John and wife Nancy, as co-founders of the organization, devoted themselves to fulfilling Arthur Marshall's dream and were actively involved on a daily basis for 17 years as chairman and president respectively.

After his uncle passed, John Marshall knew that he would dedicate his life to the preservation and restoration of the Florida Everglades and its ecosystem. He was responsible for planting thousands of trees at the refuge and other bio-sensitive areas, and delivering science-based education and public outreach programs to educate children throughout Palm Beach County to become stewards of the environment.

His commitment to the environment included chairing the Environmental Action Committee for the South Florida Water Management District; he was a member of the Everglades Coalition, a spokesman for the Florida Environmental Institute, and a vice president of the Friends of the Refuge.

John was named 2001 "Conservationist of the Year" by the Audubon of the Everglades and the Florida Wildlife Federation. He was also the recipient of the 2003 "Conservationist of the Year Award" from the Flagler chapter of Daughters of American Revolution and in 2004, received the Environmental Education Award from the Florida Association of Environmental Professionals. Most recently, Marshall received a Commendation from the Everglades Foundation for his "Leadership and Service in Protecting America's Everglades."

A career military officer, John Marshall saw active duty in the United States Marine Corps from 1963-1971, serving his country in Viet Nam where he received 19 air medals for 275 air combat missions. John was recognized on numerous occasions, including a Meritorious Unit Commendation while commanding the Headquarter & Maintenance Squadron-31, and an Acquisition Reform Proposal to the Department of Defense was endorsed by the Secretary of the Navy. He served as a U.S. Marine Corp Reserve Officer from 1971-1993 and received a Meritorious Assignment to the Office of the Secretary of Defense, Test & Evaluation in 1992 and 1993. During this time, John also received the Secretary of the Navy Marathon Man award for completing the first 17 USMC marathons. He retired as Colonel in 1993 having accomplished many significant achievements. He later served as a U.S. civil servant systems engineer until his retirement in 1997. Semper fidelis!

Blue and orange were John's colors, from his sneakers to his car. He was a passionate gator fan and graduated the University of Florida with a B.S. in Geology in 1963. He graduated Naval Flight School in Pensacola, FL in 1966 and Radar Intercept Officer School in Brunswick, GA in 1967. He continued his studies at the Navy Top Gun Fighter Weapons School in Miramar, CA, in 1970 and was a NASA Fellow in Biological Applications in Remote Sensing from 1970-1972. He received a M.S. in Systems Engineering from the University of West Florida in 1972.

John Marshall's community involvement included serving on the board of trustees of the Commandery of The Palm Beaches and the Sovereign Order of St. John of Jerusalem, Knights Hospitaller.

John, you will be missed sorely – by us and by the Everglades.

John's wife, Nancy, always knew where to find him if he wasn't in his office... ***planting more trees.***

“...John Marshall knew that he would dedicate his life to the **preservation and restoration** of the Florida Everglades and its ecosystem.”

Committee Recognition

Executive Committee

Nick Aumen, Conference Chair, U.S. Geological Survey, Davie, FL
K. Ramesh Reddy, Conference Co-Chair, University of Florida/IFAS, Gainesville, FL
Terrie Bates, South Florida Water Management District, West Palm Beach, FL
James Erskine, Florida Fish and Wildlife Conservation Commission, West Palm Beach, FL
Shannon Estenoz, U.S. Department of Interior, Davie, FL
Evelyn Gaiser, Florida International University, Miami, FL
Matt Harwell, Environmental Protection Agency, Gulf Breeze, FL
Bob Johnson, Everglades National Park, Homestead, FL
Colin Polsky, Florida Atlantic University, Davie, FL
Pedro Ramos, Everglades National Park, Homestead, FL
Tom Van Lent, Everglades Foundation , Palmetto Bay, FL
Larry Williams, U.S. Fish and Wildlife Service, Vero Beach, FL

Program Committee

Nick Aumen, Conference Chair, U.S. Geological Survey, Davie, FL
Steve Davis, Everglades Foundation, Palmetto Bay, FL
Dale Gawlik, Florida Atlantic University, Boca Raton, FL
Andy LoSchiavo, U.S. Army Corps of Engineers, Jacksonville, FL
Melissa Martin, U.S. Department of Agriculture, Natural Resource Conservation Service, Washington DC, Boynton Beach, FL
K. Ramesh Reddy, Conference Co-Chair, University of Florida/IFAS, Gainesville, FL
Dave Rudnick, Everglades National Park, Homestead, FL
Fred Sklar, South Florida Water Management District, West Palm Beach, FL
Steve Traxler, U.S. Fish and Wildlife Service, Vero Beach, FL
Joel Trexler, Florida International University, Miami, FL
Beth Miller-Tipton, Conference Coordinator, University of Florida/IFAS, Gainesville, FL

Dedicated Session Organizer Recognition

Everglades science community professionals were invited to organize sessions on topics relevant to their restoration activities. This process took several months and numerous volunteer hours. We would like to thank the following session organizers for their time, efforts, and expertise on behalf of the conference.

1 — **Dr. Matthew Harwell**, U.S. Environmental Protection Agency, Gulf Breeze, FL

2 — **Ms. Delia Ivanoff**, South Florida Water Management District, West Palm Beach, FL

5 — **Dr. Donald DeAngelis**, U.S. Geological Survey, Coral Gables, FL

6 — **Ms. Amanda McDonald**, South Florida Water Management District, West Palm Beach, FL

7 — **Ms. Delia Ivanoff**, South Florida Water Management District, West Palm Beach, FL

10 — **Dr. Greg Wheeler**, USDA-ARS, Ft. Lauderdale, FL

11 — **Dr. Thomas Van Lent,** Everglades Foundation, Palmetto Bay, FL

13 — **Mrs. Fahmida Khatun**, South Florida Water Management District, West Palm Beach, FL

15 — **Dr. Greg Wheeler**, USDA-ARS, Ft. Lauderdale, FL

16 — **Dr. Peter Kalla**, U.S. Environmental Protection Agency Region 4 Laboratory, Athens, GA

17 — **Dr. Anna Wachnicka**, Florida International University, Miami, FL

18 — **Ms. April Patterson**, U.S. Army Corps of Engineers, Jacksonville, FL

20 — **Dr. Margaret Hunter**, U.S. Geological Survey, Gainesville, FL

21 — **Dr. Luca Marazzi**, Florida International University, Miami, FL

22 — **Dr. Rene Price**, Florida International University, Miami, FL

23 — **Dr. Forrest Dierberg**, DB Environmental, Inc., Rockledge, FL, *–and–*
Mr. Paul Julian, Florida Department of Environmental Protection, Office of Ecosystem Projects, Ft. Myers, FL

25 — **Dr. Rebekah Gibble**, U.S. Fish and Wildlife Service, Boynton Beach, FL

26 — **Mr. LeRoy Rodgers**, South Florida Water Management District, West Palm Beach, FL

27 — **Dr. John Kominoski**, Florida International University, Miami, FL

28 — **Dr. James Beerens**, U.S. Geological Survey, Davie, FL

30 — **Dr. Stephanie Romañach**, U.S. Geological Survey, Ft. Lauderdale, FL

31 — **Dr. Tiffany Troxler**, Florida International University, Miami, FL

32 — **Dr. David Krabbenhoft**, U.S. Geological Survey, Middleton, WI

33 — **Dr. Pamela Fletcher**, University of Florida, Davie, FL

36 — **Dr. Jay Choi**, U.S. Geological Survey, Reston, VA

38 — **Dr. Erik Stabenau**, Everglades National Park, Homestead, FL

39 — **Dr. Jay Sah**, Florida International University, Miami, FL

41 — **Dr. Jud Harvey**, U.S. Geological Survey, Reston, VA

42 — **Dr. Fred Johnson**, U.S. Geological Survey Wetland and Aquatic Research Center, Gainesville, FL

43 — **Dr. Jennifer Rehage**, Florida International University, Miami, FL

Thank You to Our Sponsors

Without their generous support, this conference would not be possible.

Premier Sponsors

National Park Service
South Florida Water Management District
U.S. Fish & Wildlife Service
U.S. Geological Survey

Supporting Sponsors

AECOM
Center for Environmental Studies
DHI Water & Environment
Ecology and Environment, Inc.
The Everglades Foundation, Inc.
Eureka Water Probes
Miccosukee Tribe
National Audubon Society
NorthStar Contracting Group, Inc.
OTT Hydromet
Southeast Environmental Research Center, Florida International University
Stanley Consultants
University of Florida, Institute of Food and Agricultural Sciences
YSI a Xylem Brand

Contributing Sponsors

ECO Magazine

Sponsor Descriptions

Premier Sponsors

National Park Service

www.nps.gov

Since 1916, the National Park Service (NPS) has been entrusted with the care of our national parks. With the help of volunteers and partners, they safeguard these special places and share their stories with more than 275 million visitors every year. But their work doesn't stop there. The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. Tribes, local governments, nonprofit organizations, businesses, and individual citizens seek help from the NPS in revitalizing their communities, preserving local history, celebrating local heritage, and creating close to home opportunities for kids and families to get outside, be active, and have fun. Taking care of the national parks and helping Americans take care of their communities is a job the NPS loves, and they need—and welcome—your help and support.

South Florida Water Management District

www.sfwmd.gov

The South Florida Water Management District's mission is to manage and protect water resources of the region by balancing and improving flood control, water supply, water quality and natural systems. They are a regional governmental agency that manages the water resources in the southern half of Florida, covering 16 counties from Orlando to the Florida Keys and serving a population of 8.1 million residents. It is the oldest and largest of the state's five water management districts. Created in 1949, the agency is responsible for managing and protecting water resources of South Florida by balancing and improving flood control, water supply, water quality and natural systems. A key initiative is restoration of the Everglades – the largest environmental restoration project in the nation's history. The District is also working to improve the Kissimmee River and its floodplain, Lake Okeechobee and South Florida's coastal estuaries.

U.S. Fish & Wildlife Service

www.fws.gov

The U.S. Fish and Wildlife Service manages the 150 million-acre National Wildlife Refuge System of more than 560 National Wildlife Refuges and thousands of small wetlands and other special management areas. Under the Fisheries program, they also operate 70 National Fish Hatcheries, 65 fishery resource offices, and 86 ecological services field stations. The vast majority of fish and wildlife habitat is on non-Federal lands. Voluntary habitat protection and restoration programs like the Partners for Fish and Wildlife Program, the Coastal Program, and other partnership programs are the primary ways they deliver habitat conservation on public and private lands. The Service employs approximately 9,000 people at facilities across the U.S. The Service is a decentralized organization with a headquarters office in Washington, D.C., with regional and field offices across the country.

Premier Sponsor

U.S. Geological Survey

www.usgs.gov

U.S. Geological Survey serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. USGS employs the best and the brightest experts who bring a range of earth and life science disciplines to bear on problems. By integrating diverse scientific expertise, USGS is able to understand complex natural science phenomena and provide scientific products that lead to solutions. Every day the 10,000 scientists, technicians, and support staff of USGS are working for you in more than 400 locations throughout the United States. As the Nation's largest water, earth, and biological science and civilian mapping agency, USGS collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. The diversity of their scientific expertise enables them to carry out large-scale, multi-disciplinary investigations and provide scientific information intended to help educate the public about natural resources, natural hazards, geospatial data, and university-level inquiry and research.

Supporting Sponsors

AECOM

www.aecom.com

AECOM is "built to deliver a better world." We design, build, finance and operate infrastructure assets for public and private sector clients worldwide. A fully integrated firm of some 100,000 staff, we assist clients by connecting knowledge and experience across a global network of experts. From high-performance infrastructure, to resilient communities, to restored ecosystems, our services include planning, engineering, design, environmental and economic analysis, and project/program management. Our National Coastal and Ecosystem Restoration Practice features multi-disciplinary teams and formal initiatives focused on some of the nation's largest and most complex coastal reaches and river basins. From small watersheds to multi-state regions, AECOM offers locally-based teams, Subject Matter Experts in all relevant disciplines, unparalleled depth/breadth of resources, and a nationwide portfolio of signature projects.

Center for Environmental Studies

www.ces.fau.edu

The Florida Center for Environmental Studies (CES) at Florida Atlantic University is dedicated to advancing Florida's sustainability by seeding collaborative research, education, and community engagement activities related to wetlands ecology and coastal resilience. For more information, please visit www.ces.fau.edu or call 954-236-1104.

DHI Water & Environment

www.dhigroup.com

DHI is a global expert in water environments and is renowned for the development and application of the MIKE by DHI water modeling software tools. At DHI, our world is water, and our knowledge of water environments is second-to-none, and we strive to make this knowledge globally accessible to clients and partners by channeling it through our local teams and our industry leading software products.

Ecology and Environment, Inc.

www.ene.com

Ecology and Environment, Inc. (E & E) is a global network of innovators and problem solvers, dedicated professionals and industry leaders in scientific, engineering, and planning disciplines working together to develop technically sound, science-based solutions to the leading environmental challenges of our time.

Eureka Water Probes

www.waterprobes.com

Eureka Water Probes - Designer and manufacturer of premium water quality monitoring sondes and systems. Offering an industry leading 3 year warranty on sondes with up to 11 sensors. Eureka provides the easiest to use, most reliable equipment anywhere!

The Everglades Foundation, Inc.

www.evergladesfoundation.org

The Everglades Foundation is a 501(c)(3) non-profit dedicated to leading efforts to restore and protect the greater Everglades ecosystem. Since its founding in 1993 by a group of local outdoor enthusiasts, the Foundation has become a respected and important advocate for the sustainability of one of the world's most unique ecosystems. Funds raised by the Foundation are used for scientific research, advancing understanding of the Greater Everglades ecosystem and to provide grants to our conservation partners. In addition to grants, the Foundation supports necessary legal actions to help protect the Everglades. Through environmental leadership, scientific expertise and policy experience, the Everglades Foundation works to protect and restore America's Everglades.

Miccosukee Tribe

www.miccosukeetribe.com

Miccosukee Tribe of Indians is a federally recognized Indian Tribe residing in the historic Florida Everglades – an area referred to as a "River of Grass" by legendary environmental and social activist Marjory Stoneman Douglas. In their own Miccosukee language, the Tribe uses the word "Kahayatle" to refer to the shimmering waters of this natural treasure. In fact, Ms. Douglas traces the etymology of the word "Everglades" revealing that it originates from the same description of the quality of light glimmering on the grassy waters. The Miccosukees strongly maintain their unique way of life, ancient customs, and spirituality. It is the goal of the Tribe to articulate its beliefs and values by transmitting the essence of their heritage to their descendants. This mission is also expressed in their form of government, which is inspired by centuries-old practices and traditions. A poetic metaphor for the Miccosukee philosophy can be found in the colors of their flag, an artistic image that represents the Circle of Life.

National Audubon Society

www.audubon.org

Audubon's mission is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity. One critical component of this mission is to use sound science to support our efforts. To this end, Audubon scientists perform original peer-reviewed ecological research that is the basis for our conservation efforts. We have been actively performing ecosystem level studies in the Everglades since 1939.

NorthStar Contracting Group, Inc.

www.northstar.com

NorthStar Group Services, Inc. (www.northstar.com) is the premier facility and environmental solutions company in the United States. We offer a vast array of services to our clients in the commercial, industrial, and government sectors and with annual revenues exceeding $600 million we are the largest demolition and asbestos abatement firm in the nation. NorthStar brings industry leading resources to each and every project – both large and small. NorthStar has a proven track record of safety and performance dating back to 1986. Our experienced team of executives, managers, associates and field personnel are the best in the business. We bring answers. Our Florida operation, operating as NorthStar Contracting Group, Inc., is a leading provider of engineering, consulting and program management services that enhance the infrastructure and environment throughout Florida. With offices located in Tampa, Tallahassee, West Palm Beach, and Orlando, we serve multiple State agencies, various municipalities and numerous private sector clients throughout the region. We value passion, respect, diversity, flexibility, and teamwork. We employ highly skilled professionals who are eager, energetic, positive and client focused.

OTT Hydromet

www.ott.com

OTT Hydromet, a member of Hach Company, helps water resource professionals generate reliable data throughout the entire water cycle. We go beyond simply providing solutions by partnering with our customers in designing effective answers to the challenges they encounter in their vital role of monitoring the world's water. Proudly formed from five separate companies (OTT, Hydrolab, ADCON Telemetry, Sutron and Lufft), OTT Hydromet offers the combined strength and expertise of leaders in the water quality, quantity and telemetry fields and over 140 years of experience in environmental measurement.

Southeast Environmental Research Center, FIU

www.serc.fiu.edu

Florida International University (FIU) is designated as a top-tier Carnegie research institution serving South Florida with more than 54,000 students. FIU is Worlds Ahead in finding solutions to the most challenging problems of our time. An integral part of the College of Arts, Sciences & Education (CASE), the School of Environment, Arts & Society (SEAS) is one of three schools designed to increase hands-on learning opportunities for students. By bringing together the natural sciences, social sciences and humanities, SEAS is transforming the way we conduct research, educate students and engage the community. With faculty in the departments of Biological Sciences, Earth and Environment, and English, SEAS is preparing students to become leaders and address the world's multi-dimensional environmental issues through a revolutionary approach to full-spectrum education. The school also houses many of FIU's prominent centers and programs, and offers unique opportunities through community partnerships with organizations in Miami and beyond.

Stanley Consultants

www.stanleyconsultants.com

Stanley Consultants is a global engineering firm that provides planning, design, consulting, construction and management services to clients with complex challenges in power generation and delivery, transportation, water, utility plants, buildings and the environment. Our experts work across markets and geography to collaborate with clients, communities and colleagues and share a passion for complex problem solving. It's that passion that drives our creativity and innovation, creating bold solutions for our clients. Founded in 1913, Stanley Consultants has a staff of 1,100 members in 31 offices and has worked in all 50 states, U.S. territories and in 110 countries around the world. Engineering News Record (ENR) magazine ranks Stanley Consultants 22nd in power, 15th in transmission and distribution, 42nd in water supply, 194th in environmental, and 73rd in overall top 500 design firms in the United States. Internationally, ENR ranks Stanley Consultants 129th among the top 225 firms. We inspire powerful minds by embracing a global mindset, diversity and training to build skills that stretch the imagination. We refer to our employees as "members" and are proud of our 100 percent member ownership. As owners, our members have a vested interest in successfully serving our clients and share in the inherent rewards that come with our success.

UF/IFAS, Institute of Food and Agricultural Sciences

www.ifas.ufl.edu

The University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) is a federal-state-county partnership dedicated to developing knowledge in agriculture, human and natural resources, and the life sciences, and enhancing and sustaining the quality of human life by making that information accessible. While extending into every community of the state, UF/IFAS has developed an international reputation for its accomplishments in teaching, research and Extension. Because of this mission and the diversity of Florida's climate and agricultural commodities, IFAS has facilities located throughout Florida.

YSI a Xylem Brand

www.ysi.com

YSI a Xylem brand designs and manufactures world class water quality instruments that are used in every environment. Our equipment supports Everglades researchers through providing accurate and capable equipment that is simple to use with local technical support should an issue arise. Xylem also produces affordable flow and level equipment through our SonTek and WaterLog brands that can be found monitoring water throughout the Everglades.

Contributing Sponsor

ECO Magazine

www.ecomagazine.com

Published nine times a year in print and digital formats, each issue of Environment Coastal & Offshore (ECO) Magazine presents critical business intelligence for professionals in all disciplines of this multi-faceted industry including offshore oil & gas, government agencies, utilities, renewable ocean energy, academia, international banking, engineering, and construction. Highlighting the five key environmental areas of Science, Technology, Economics, Regulatory & Policy, and HSSE, ECO provides insight through a mix of in-depth articles, analytics, and news on the latest projects, trends, technology and policy.

Pre-Conference Workshop 1

Water, Energy and Carbon Cycling within Greater Everglades Ecosystems

Monday, April 17, 2017 – 10:00 AM to 5:00 PM (Ibis)

Organizers:

- **Barclay Shoemaker** (U.S. Geological Survey, Davie, FL)
- **Frank Anderson** (U.S. Geological Survey, Sacramento, CA)
- **Brian Benscoter** (Florida Atlantic University, Davie, FL)

Objective

Workshop participants will learn about the historic, present and future state of water, energy and carbon cycles within Greater Everglades ecosystems.

Background

For centuries, the Greater Everglades has grown and evolved in response to water availability, sunlight, and photosynthetic capacity to store atmospheric carbon as peat soil. Modern disturbances - such as construction of extensive drainage features for populous communities - have fundamentally altered water, energy and carbon cycles while provoking the largest restoration program in the world. This workshop will exchange scientific ideas regarding the historic, current and future condition of Everglade's water, energy and carbon cycles - including possible management actions to improve ecosystem services, resiliency, and recreational wilderness experiences.

Topics Presented:

(1) Atmospheric exchanges of greenhouse gases measured with soil gas-traps and eddy-covariance methods;

(2) Regional-scale remotely-sensed carbon uptake rates;

(3) Lateral hydrologic fluxes of dissolved/particulate organic/inorganic carbon within key drainage features;

(4) The role of fire, hydro-period and hurricanes in long-term net radiative forcing;

(5) Geologic and geophysical delineation of peat soil thickness and historic changes in thickness; and

(6) Soil oxidation/preservation strategies such as hydration and flooding.

Lessons learned from similar wetlands studies are welcomed for discussion of possible transfer-value to the greater Everglades. Finally, location-based working groups (headwaters, central, and southern Everglades) will be assembled to discuss scientific posters and identify emerging issues and priorities for future study.

Workshop Benefits

At the conclusion of the workshop, attendees will have a better understanding of the historic, current and future state of water, energy and carbon cycles within the Greater Everglades. Workshop findings will be used to identify emerging issues and research priorities.

Pre-Conference Workshop 2

Enhancing Engagement & Team Science: Skills & Strategies to Involve Stakeholders and Strengthen Teams in Everglades Restoration Efforts

Monday, April 17, 2017 – 10:00 AM to 5:00 PM (Sandpiper)

Workshop Objective

Stakeholder engagement and collaborative science are cornerstones of Everglades restoration efforts. What are they and how can we do them effectively? This workshop provides participants with practical concepts, tools, and approaches to make stakeholder engagement and team science a constructive experience whether you are leading or participating in a given process.

Workshop Description

Addressing an issue as large, complex, and dynamic as Everglades restoration requires a specialized set of skills, tools, and strategies to build trust and promote collaboration among competing interest groups, including scientists. How can we address conflicting needs and perspectives and facilitate inclusive engagement processes?

This interactive and experiential workshop is designed for individuals working in science teams and/or participating in stakeholder-focused activities. It will provide participants with:

- An understanding of the value of participatory decision-making
- A practical framework for situation assessment
- An opportunity to exchange experiences and learn from one another
- Tools for identifying and analyzing the roots of conflict
- Strategies for effective stakeholder interactions and for effective team science

Workshop Instructors

Dr. Wendy-Lin Bartels, Florida Natural Resources Leadership Institute, University of Florida/Institute of Food and Agricultural Sciences

Mr. Jonathan Dain, Director, Florida Natural Resources Leadership Institute, University of Florida/Institute of Food and Agricultural Sciences

Mr. James Erskine, Everglades Coordinator, Florida Fish and Wildlife Conservation Commission

Dr. Pamela Fletcher, Extension Assistant Scientist, University of Florida-Institute for Food and Agricultural Sciences, and Sea Grant Laboratory Liaison, NOAA/AOML Ocean Chemistry and Ecosystems Division

Dr. Paul Monaghan, Florida Natural Resources Leadership Institute, University of Florida/Institute of Food and Agricultural Sciences

If you are interested in finding out more about stakeholder engagement or team science strategies, contact:

Jessica Ireland | Program Coordinator | Florida Natural Resources Leadership Institute | School of Forest Resources and Conservation | University of Florida/IFAS | Phone: (352) 294-7643 | E-mail: jjtireland@ufl.edu

Plenary Session Descriptions

Tuesday, April 18, 2017 | 8:30am – 10:00am | Opening Plenary
[Great Cypress & Royal Poinciana]

Bridging Science to Management in Large-scale Ecosystem Restoration Programs

Session Description

After welcoming remarks from the conference organizers, this plenary session will examine science-management linkages and processes. We will hear the perspectives of two scientists who have been involved in several large-scale ecosystem restoration programs, including the San Francisco Bay-Delta, the Great Lakes, Chesapeake Bay, and the Gulf of Mexico. The speakers will discuss findings from a workshop that brought together scientists and science-policy experts from across the country, and how ecosystem forecasting can help bridge science to management.

Plenary Speakers

Opening Remarks by GEER 2017 Conference Chair
Nick Aumen, *Regional Science Advisor - South Florida*, U.S. Geological Survey, Davie, FL

Welcome and Introductions
Jack Payne, *Senior VP for Agriculture and Natural Resources*, University of Florida/IFAS, Gainesville, FL

Cultivating Reproducible Science and Social Capital in Major Science Enterprises
Mike Chotkowski, *San Francisco Bay-Delta Science Coordinator*, U.S. Geological Survey, Sacramento, CA

Ecosystem Forecasting: Bridging Science to Management
Stephen Brandt, *Professor*, Oregon State University, Corvallis, OR

Session Organizer

Nick Aumen, *Regional Science Advisor – South Florida*, U.S. Geological Survey; GEER 2017 Chair

Wednesday, April 19, 2017 | 8:30am – 10:00am | Plenary Session
[Great Cypress & Royal Poinciana]

Design, Innovation, and Governance (DIG): Solutions for Everglades Restoration

Session Description

This year, the panel that selects plenary speakers and topics wanted to try something different. This will be a TED-like presentation by six panelists who received individualized coaching on the art of TED presentations**. TED (Technology, Entertainment, and Design) talks have become the gold standard for the communication of "ideas worth spreading." In this session we are adapting the short, focused TED story-telling format for this session entitled: "Solutions for Everglades Restoration." With a more panoptic view then a typical GEER session, panelists were asked to deliver thoughtful and possibly provocative Everglades-focused and science-centric DIG (Design, Innovation and Governance) Talks. Sessions that DIG deeper may become a mainstay of future GEER conferences. This session promises to be a unique blend of the art of communication with the passion of science. Topics will cover a range of ideas including animal behavior, sustainability, citizen science and the governance of restoration, with a special appearance by the Honorable Florida Senator Robert "Bob" Graham.

**Footnote: Jezra Kaye, Speak Up for Success (Jezra@JezraKaye.com), Speaker Coach / President;

Plenary Speakers

Sustainability
Dan Childers, *Professor*, Arizona State University, Tempe, AZ

The Allegory of the Patient
Fred Sklar, *Director and Section Administrator*, Everglades Systems Assessment Section, South Florida Water Management District, West Palm Beach, FL

Keeping it Real
Stephanie Johnson, *Senior Program Officer*, National Academy of Sciences, Washington, DC

The Value of Citizen Science
Jennifer Rehage, *Assistant Professor*, Florida International University, Miami, FL

Bird Brains
Peter Frederick, *Research Professor*, University of Florida/IFAS, Gainesville, FL

Resource Governance
The Honorable **Robert "Bob" Graham**, *former Florida Governor and United States Senator*, Miami Lakes, FL

Session Organizers

Fred Sklar, *Director and Section Administrator*, Everglades Systems Assessment Section, South Florida Water Management District, West Palm Beach, FL *–and–*
Nick Aumen, *Regional Science Advisor – South Florida*, U.S. Geological Survey; GEER 2017 Chair

Closing Keynote Presentation

Michael Grunwald, Author, South Beach, FL

Thursday, April 20, 2017 | 6:00pm – 7:00pm

Michael Grunwald is a best-selling author, a senior writer for *Politico Magazine*, and the Editor-at-Large of POLITICO's new public policy site, *The Agenda*. He has won the George Polk Award for national reporting, the Worth Bingham Prize for investigative reporting, and many other honors.

After growing up on Long Island and graduating from Harvard College, Mike spent six years as a reporter for *The Boston Globe*. In July 1998, he joined the national staff of *The Washington Post*, where he was an investigative reporter, political reporter, New York bureau chief and Outlook essayist; he also wrote the lead news story on the September 11 attacks. He joined *TIME Magazine* as a senior national correspondent in 2007, writing several dozen cover stories as well as columns about politics and energy.

In 2014, Mike started at POLITICO, where he has covered the Obama administration and the 2016 campaign. He has appeared on every major television network, and often does public speaking about national politics and policy as well as Florida issues.

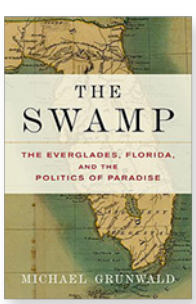
In 2006, Simon & Schuster published Mike's first book, *The Swamp: The Everglades, Florida, and the Politics of Paradise*. It was praised as "brilliant" (The Washington Post), "magnificent" (The Palm Beach Post), and "terrific" (The New York Times). In August 2012, Simon & Schuster published his second book, *The New New Deal: The Hidden History of Change in the Obama Era*. It received similar critical acclaim—*The Economist* and *The Guardian* both declared it the best book about the Obama administration—and made the New York Times best-seller list.

Mike is married to Cristina Dominguez, an attorney. They live in South Beach with their son Max, their daughter Lina, and their Boston Terriers, Candy and Cookie.

Book Signing and Meet & Greet with the Author

Thursday, April 20, 2017 | 7:00pm – 8:00pm

Both of the following books will be available for $20 each (cash only please).



The Swamp

The Everglades, Florida, and the Politics of Paradise

New York Times Bestseller

The New New Deal

The Hidden Story of Change in the Obama Era

New York Times Bestseller

Synopsis of *The Swamp*

The Everglades was once reviled as a liquid wasteland, and Americans dreamed of draining it. Now it is revered as a national treasure, and Americans have launched the largest environmental project in history to try to save it. *The Swamp* is the stunning story of the destruction and possible resurrection of the Everglades, the saga of man's abuse of nature in southern Florida and his unprecedented efforts to make amends. Michael Grunwald, a prize-winning national reporter for *The Washington Post*, takes readers on a riveting journey from the Ice Ages to the present, illuminating the natural, social and political history of one of America's most beguiling but least understood patches of land.

The Everglades was America's last frontier, a wild country long after the West was won. Grunwald chronicles how a series of visionaries tried to drain and "reclaim" it, and how Mother Nature refused to bend to their will; in the most harrowing tale, a 1928 hurricane drowned 2,500 people in the Everglades. But the Army Corps of Engineers finally tamed the beast with levees and canals, converting half the Everglades into sprawling suburbs and sugar plantations. And though the southern Everglades was preserved as a national park, it soon deteriorated into an ecological mess. The River of Grass stopped flowing, and 90 percent of its wading birds vanished.

Now America wants its swamp back. Grunwald shows how a new breed of visionaries transformed Everglades politics, producing the $8 billion rescue plan. That plan is already the blueprint for a new worldwide era of ecosystem restoration. And this book is a cautionary tale for that era. Through gripping narrative and dogged reporting, Grunwald shows how the Everglades is still threatened by the same hubris, greed and well-intentioned folly that led to its decline.

Synopsis of *The New New Deal*

In a riveting account based on new documents and interviews with over 400 sources on both sides of the aisle, award-winning reporter Michael Grunwald reveals the vivid story behind President Obama's $800 billion stimulus bill, one of the most important and least understood pieces of legislation in the history of the country. Grunwald's meticulous reporting shows how the stimulus, though reviled on the right and the left, helped prevent a depression while jump-starting the president's agenda for lasting change. As ambitious and far-reaching as FDR's New Deal, the Recovery Act is a down payment on the nation's economic and environmental future, the purest distillation of change in the Obama era.

The stimulus launched a transition to a clean-energy economy, doubled our renewable power, and financed unprecedented investments in energy efficiency, a smarter grid, electric cars, advanced biofuels, and green manufacturing. It is computerizing America's pen-and-paper medical system. Its Race to the Top is the boldest education reform in U.S. history. It has put in place the biggest middle-class tax cuts in a generation, the largest research investments ever, and the most extensive infrastructure investments since Eisenhower's interstate highway system. It includes the largest expansion of anti-poverty programs since the Great Society, lifting millions of Americans above the poverty line, reducing homelessness, and modernizing unemployment insurance. Like the first New Deal, Obama's stimulus has created legacies that last: the world's largest wind and solar projects, a new battery industry, a fledgling high-speed rail network, and the world's highest-speed Internet network.

Michael Grunwald goes behind the scenes—sitting in on Cabinet meetings, recounting the secret strategy sessions where Republicans devised their resistance to Obama—to show how the stimulus was born, how it fueled a resurgence on the right, and how it is changing America. *The New New Deal* shatters the conventional Washington narrative, and it will redefine the way Obama's first term is perceived.

Biographies

Conference Chairs

Nicholas G. Aumen

GEER 2017 Conference Chair
Regional Science Advisor - South Florida
U.S. Geological Survey, Davie, FL

Nick Aumen is Regional Science Advisor for the U.S. Geological Survey (Southeast Region), overseeing the Greater Everglades Priority Ecosystem Sciences program. This program, involving USGS scientists nationwide, provides high quality science in support of Everglades restoration. Nick was an aquatic ecologist for 15 years with Everglades National Park, leading an interagency team of scientists tracking restoration progress. Prior to his National Park Service position, Nick was the Research Director at the South Florida Water Management District, directing a team of 120-plus scientists conducting research in support of ecosystem restoration. Nick received his B.S. and M.S. in biology at the University of West Florida, and his Ph.D. in microbial ecology at Oregon State University. He was a faculty member in the Biology Department at the University of Mississippi, and was a tenured Associate Professor of Biology when he returned to Florida. Nick presently is an affiliate faculty member at Florida Atlantic University (Department of Geosciences), and at the University of Florida (Soil and Water Science Department). He also served five years on the national Board of Directors of the Sierra Club, a 120-yr-old environmental organization with more than 750,000 members, and served two terms as its Vice-President and one as Treasurer.

K. Ramesh Reddy

GEER 2017 Conference Co-Chair
Graduate Research Professor & Department Chair
University of Florida, IFAS, Soil and Water Science Department

Dr. K. Ramesh Reddy is graduate research professor and chair of the Soil and Water Science Department at the University of Florida. He holds a Ph.D. in soil science with specialization in biogeochemistry from Louisiana State University. He conducts research on coupled biogeochemical cycling of nutrients and other contaminants in wetlands and aquatic systems, as related to water quality, carbon sequestration, ecosystem productivity, and restoration. He has worked on Florida's wetlands and aquatic systems for more than 35 years. Dr. Reddy established an interdisciplinary program on biogeochemistry of wetlands and aquatic systems, through the Wetland Biogeochemistry Laboratory (WBL) established within the SWSD. Since its establishment in 1987, the WBL has provided a home for graduate students from various disciplines, postdoctoral associates and visiting scientists. Examples of teaching, research, and extension activities of the WBL can be seen at the web site: www.soils.ifas.ufl.edu/wetlands. He has served on numerous advisory committees at state, national, and international levels. He has served on the National Research Council Committee on Soil Science and the Committee on Independent Scientific Review of Everglades Restoration Progress. He also served on several U.S. Environmental Protection Agency committees including the Science Advisory Board Ecological Effects Committee, Wetland Connectivity Panel, and Lake Erie Phosphorus Objective Panel.

Plenary Session Speakers, Facilitators, and Organizers

(In alphabetical order by presenter last name)

Stephen B. Brandt

Professor, Oregon State University, Corvallis, OR

Dr. Stephen Brandt is a tenured professor in the Department of Fisheries and Wildlife at Oregon State University. He holds Masters and Doctoral Degrees in Limnology and Oceanography from the University of Wisconsin, Madison. Dr. Brandt specializes in fish ecology and management of marine and freshwater ecosystems. He has produced over 120 scientific publications, given 250 scientific presentations, led over 80 research cruises and spent over 800 days at sea studying ocean food webs, fish growth and bioenergetics, underwater acoustics, coastal hypoxia and physical/biological interactions in a wide variety of ecosystems including the Great Lakes, Chesapeake Bay, the Gulf of Mexico, the Adriatic Sea, Eastern Indian Ocean, South Pacific Ocean, Western Atlantic Ocean and Sargasso Sea. As part of the Federal Senior Executive Service, he directed the NOAA Great Lakes Environmental Research Laboratory for 12 years and earned the Presidents Rank Award for Meritorious Service. He created and led the NOAA Center of Excellence for Great Lakes and Human Health and served as President of the International Association for Great Lakes Research. Previously, he has held tenured faculty positions in Maryland at the Chesapeake Biological Laboratory and in New York (Buffalo, Syracuse) and spent 5 years in Australia working on Deep-Sea Biology. More recently, Dr. Brandt directed the Oregon Sea Grant Program and served as a member of the Oregon's Ocean Policy Advisory Council (OPAC). He is currently chair-elect of the California Delta Independent Science Board.

Dan Childers

Professor, Arizona State University, Tempe, AZ

Dan Childers is a Professor in the School of Sustainability at Arizona State University. He is the Director of the Central Arizona-Phoenix LTER Program and co-Director of the Urban Sustainability Research Coordination Network, both of which are funded by the National Science Foundation (NSF). He has also been the Director of the Florida Coastal Everglades Long-Term Ecological Research (LTER) Program. His research focuses on wetland ecosystem ecology, urban ecology, and sustainability science. Dan has conducted research in many different freshwater and estuarine ecosystems around the world, including working for nearly 15 years in the Florida Everglades. In the last decade he has expanded his research portfolio to include urban ecosystems, water dynamics in cities, urban sustainability, and urban wetlands. Dan has published more than 120 peer-reviewed articles, won grants that have totaled over $30 million, and advised more than 30 Ph.D. and M.S. students.

Mike Chotkowski

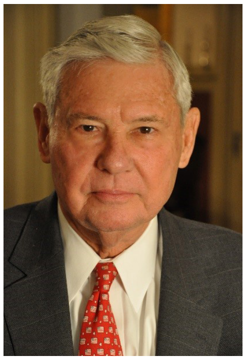
San Francisco Bay-Delta Science Coordinator, U.S. Geological Survey, Sacramento, CA

Mike Chotkowski has a doctorate in Biology from UCLA. Mike has worked for Department of the Interior bureaus for almost twenty years. He began his career as a research fishery biologist with the U.S. Bureau of Reclamation in the late 1990s, eventually becoming manager of Reclamation's regional science and water quality programs. From 2011 to 2015, Mike served as Project Leader of the U.S. Fish and Wildlife Service's San Francisco Bay-Delta Fish and Wildlife Office. Since 2015, Mike has served the Pacific Region of the USGS as San Francisco Bay-Delta Science Coordinator. The San Francisco Estuary has been a common theme through Mike's career. His experiences have afforded him the opportunity to see the evolution of science practice and public policy pertaining to contentious resource management issues from the perspectives of a working scientist, a resource manager, and a science program manager.

Peter Frederick

Research Professor, University of Florida/IFAS, Gainesville, FL

Peter Frederick is a Research Professor in Wildife Ecology and Conservation at University of Florida. As a wetland scientist he has studied breeding ecology and ecotoxicology of long legged wading birds in the Everglades and other tropical and subtropical wetlands for over 30 years. His studies of the effects of mercury on wildlife have been both extensive and intensive, and have documented consequences that are integrated from cellular, organ, physiological, individual and population levels. He has been involved in integrating science into restoration and conservation activities throughout Florida, and served for six years as a governor appointee on the Acquisition and Restoration Council, which advises on conservation land management and land purchases for the Florida Forever program. Dr. Frederick has been involved in planning and monitoring Everglades restoration since its inception, and recently served on a 6-member team employed by the Florida Senate to summarize potential solutions to linked problems of water shortage, water pollution, and restoration in south Florida.



The Honorable Robert "Bob" Graham

Former Florida Governor and United States Senator, Miami Lakes, FL

Senator Bob Graham is the former two-term governor of Florida and served for 18 years in the United States Senate. This is combined with 12 years in the Florida legislature for a total of 38 years of public service. Bob Graham retired from public service in January 2005, following his Presidential campaign in 2004.

Bob Graham is recognized for his leadership on issues ranging from education, economic development, healthcare, environmental preservation and his service on the Senate Select Committee on Intelligence — including eighteen months as chairman in 2001–2002. After retiring from public life, Senator Graham served for a year as a senior fellow at the Harvard Kennedy School of Government.

In May of 2010, Senator Graham was appointed by the President to serve as Co-Chair of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. This followed his service as a Commissioner on the Financial Crisis Inquiry Commission and as the Chairman of the Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism. Currently he serves as chairman of the WMD Center, a 501c3 not for profit research organization which continues the work of the Commission.

Senator Graham serves as a member of the CIA External Advisory Board, as a member of the board of directors of several companies and as the chair of the Board of Overseers of the Bob Graham Center for Public Service at the University Florida. He is also the author of several books including “America: The Owner’s Manual,” which teaches the skills of civic participation, and “Keys to the Kingdom,” a novel of suspense which draws upon his background in government and intelligence.

Stephanie Johnson

Senior Program Officer, National Academy of Sciences, Washington, DC

Stephanie Johnson is a senior program officer with the National Academies of Sciences, Engineering, and Medicine, a non-governmental organization that provides independent, objective analysis and advice to the nation. Since joining the Water Science and Technology Board of the National Academies in 2002, she has worked nearly continuously on Everglades-related studies and has served as the study director for all six of the Academies’ congressionally mandated independent reviews of Everglades restoration progress. In this role, she has worked to ensure that the reviews provide useful, science-based guidance to the CERP program to enhance ecosystem restoration progress.

Stephanie has also worked on a wide array of other topics, including studies on Chesapeake Bay nutrient management, Gulf of Mexico restoration monitoring, wastewater and graywater reuse, desalination, coastal risk, and coal and uranium mining. She is the study director of the newly launched Committee on Grand Challenges and Opportunities for Environmental Engineering and Sciences for the 21st Century.

Previously, she worked as a hydrologist with the U.S. Geological Survey. Stephanie received her Ph.D. in environmental sciences from the University of Virginia.

Jack M. Payne

Senior Vice President for Agriculture and Natural Resources
University of Florida, Institute of Food and Agricultural Sciences (IFAS), Gainesville, FL

Jack Payne is the Senior Vice President for Agriculture and Natural Resources at the University of Florida and the Administrative Head for the Institute of Food and Agricultural Sciences. Prior to his current position he served as a Vice President at Iowa State University, and, previous to Iowa State, he was a Vice President and Dean at Utah State University. Jack also has experience at two other land-grant institutions: Pennsylvania State University, where he served on the faculty of the School of Forest Resources, and, later, at Texas A&M University, where he served as a faculty member in the Fisheries and Wildlife Department.

After leaving Texas A&M University, Payne had a long career with Ducks Unlimited (DU), as their National Director of Conservation. While at Ducks Unlimited, some of his successes included the development of DU's private lands program with agriculture, the development of a national conservation easement program and the expansion of their Mexican program to Central and South America.

Payne received his M.S. in Aquatic Ecology and his Ph.D. in Wildlife Ecology from Utah State University and is a graduate of the Institute for Educational Management at Harvard University. He is a tenured professor in the Department of Wildlife Ecology and Conservation at the University of Florida.

Jennifer Rehage

Assistant Professor, Florida International University, Miami, FL

Dr. Jennifer Rehage is a fish ecologist and associate professor in the Earth and Environment Department at Florida International University. Over the past 13 years, Dr. Rehage has been studying how changes to the natural hydrology of the Everglades affect fish communities in the freshwater and coastal reaches of the ecosystem.

Her research examines the interacting effects of water, climate, and management decisions on fish across multiple scales, from their individual behavior to ecological populations and communities, and socioecological scales. Studies by her lab use a variety of tools from tagging studies in the field, to experiments and the use of angler records to better understand how fish are affected by both natural and anthropogenic disturbance.

Recent research integrates human dimensions to better understand how economically-important recreational fisheries such as snook and bonefish respond to variation in hydroclimatic drivers and to ongoing and future Everglades restoration efforts. Her work relies on angler knowledge and involves anglers in citizen science in her research. Jennifer received her PhD from the University of Kentucky, where she specialized in studying fish behavior and the implications of behavior for the functioning of ecological communities.

Fred H. Sklar

Director and Section Administrator, Everglades Systems Assessment (ESA) Section,
South Florida Water Management District, West Palm Beach, FL

Fred H. Sklar has a Masters in Oceanography and a Ph.D. in Wetland Ecology. He has been studying, evaluating and managing coastal and freshwater ecosystems of the United States since 1976. Dr. Sklar was the scientific coordinator for the North Inlet Long-Term Ecological Research (LTER) program at the University of South Carolina from 1987-1993. He is currently the Director of the Everglades Systems Assessment Section of the South Florida Water Management District (District) in West Palm Beach. Dr. Sklar is an Associate Editor for the journal: Frontiers in Ecology and the Environment; a member of the National Environmental Advisory Board to the Chief of the US. Army Corps of Engineers; a member of the Louisiana Science and Engineering Advisory Committee for the Water Institute of the Gulf; and an executive member of the steering committee for the Florida Coastal Ecosystem LTER Program.

Dr. Sklar has published 100+ articles and reports on the hydrology, soil, plant and animal processes associated with both the degradation and restoration of wetland and coastal ecosystems. Dr. Sklar became national recognized for his post-doctoral studies in Louisiana, where he was the first person to ever integrate super-computer numeric and graphic processing to simulate wetland evolution and succession as a consequence of sea level rise.

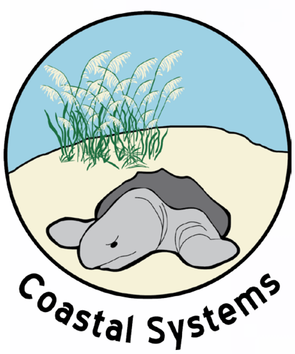
The Florida Master Naturalist Program

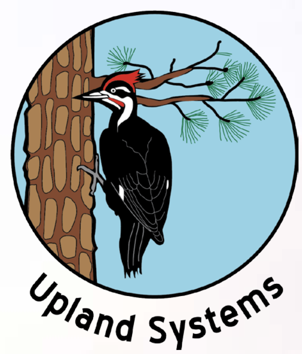
A Natural History Training Program

The Florida Master Naturalist Program (FMNP) is a University of Florida/IFAS Extension environmental education program for adult audiences. FMNP courses are provided by Certified Instructors throughout the state of Florida at Extension offices and other environmental education organizations.

The goal of FMNP is to promote awareness, understanding, and respect of Florida's natural world. FMNP graduates share their knowledge through formal and informal training programs. FMNP consists of three Core Modules and four Special Topics focused on the following:

Core Modules





Special Topics

UF | IFAS
UNIVERSITY *of* FLORIDA

Florida Master Naturalist Program

Hands-on Learning

Explore our Wildlife

Visit us online at:

www.MasterNaturalist.org

Session Descriptions

Tuesday, April 18, 2017 | 10:20am – 12:00noon

1 – The Utility of Strategic Communication to the GEER Community of Practice

Great Cypress

The field of Strategic Communication involves a focused effort to identify, develop, and present multiple types of communication media on a given subject. A Strategic Communication program recognizes the limitations of the most common communication models (primarily "one size fits all" and "presenting everything and letting the audience decide what is important") and specifically focuses on building a communication framework that is composed of three interlinked pillars:

- Message – Identifying the right content for a given audience and a vehicle
- Audience – Identify the right target group for a given message and vehicle
- Vehicle – Identifying the right types of media for a given message and audience

In addition to serving as an organizational framework, the physical structure of a Strategic Communication plan also can serve as a way to show an audience where they, the message, and vehicle fit into the larger picture (i.e., "you are here").

This special session will explore the tenets of Strategic Communication as it relates to advancing restoration activities in the Greater Everglades. Speakers will introduce the field of Strategic Communication and its use in natural resources management, and discuss example elements of Strategic Communication from their program's activities as a GEER practitioner. Challenges in implementation will also be explored.

2 – Everglades Stormwater Treatment Areas: Understanding the Flow-Way Black Box - Part I

Royal Poinciana

The Everglades Stormwater Treatment Areas (STAs) are a critical component of Everglades restoration. To date, the 57,000 acres of STAs have treated 2.1 million hectare-meter (ha-m) of runoff, reduced the load to the Everglades protection Area by 76%, and reduced the runoff concentrations from 135 to 32 µg/L. More stringent regulatory limits (13 µg/L long-term and 19 µg/L annual flow-weighted mean concentration) require further improvement of the facilities, as well as refinement of operation and management strategies based on scientifically-derived information. The purpose of these sessions is to share knowledge about the STAs and its complex components, and gather ideas on how to further improve STA performance. Attendees who will benefit the most from these sessions are scientists, engineers, modelers, and students who are looking to learn more about large-scale treatment wetlands, including their link to the Everglades Restoration effort, the various mechanisms of phosphorus reduction, the challenges and successes in operating these areas, and current scientific efforts that are underway.

3 – Tools in Support of Restoration and Invasive Species Science and Management

Ibis

Technology continues to advance in support of Everglades Restoration planning and design. New advances in remote sensing, 3-D modeling, invasive sniffing dogs, and cell phone applications and their application in Everglades science and management are presented.

4 – Controls on Wildlife Population Dynamics

Egret

Models of population dynamics of key species are used for evaluation of restoration alternatives and planning. This session includes presentations addressing advanced modeling approaches and analysis of species traits necessary to parameterize management models. Taxa covered include wading birds, eagles, and bonefish in studies of movement patterns, resource selection and food limitation, and territory use.

5 – Applying Innovative Modeling Approaches to Protect and Restore the Greater Everglades

Sandpiper

Innovative approaches to modeling can increase fundamental ecological understanding and inform management decisions concerning ecosystem protection and restoration in the Greater Everglades. Recent progress in complex systems analysis and modeling provides for more accurate characterization of the expected outcomes of alternative management actions. Management decisions play out within a dynamic complex of environmental stressors, including pollutants, land-use change, invasive species, sea level rise, and climate change. Innovations include combining a real-time water-level network with a numerical hydrologic-forecasting model, advances in time series analysis and equation-free modeling, integration of optimization techniques with agent-based modeling, and improvements in ecosystem simulation to usefully address management challenges in protecting and restoring ecosystem. Contributors to this session will present examples of this recent progress to environmental management issues in southern Florida.

Tuesday, April 18, 2017 | 1:20pm – 3:00pm

6 – Status, Causes, and Consequences of Ongoing, Large-Scale Seagrass Die-off in Florida Bay

Great Cypress

In the late 1980s, a massive seagrass die-off event in Florida Bay began years of cascading ecological impacts and triggered a push for restoration of the Everglades ecosystem. In 2015, another die-off event occurred, which has allowed scientists to re-examine the drivers hypothesized for the original die-off and track the subsequent changes with the monitoring programs that have been established since the original die-off event. Presentations describing historical and current conditions of water quality and benthic ecology will be of interest for researchers and resource managers hoping to gain understanding of the event and its ecological consequences, as well as insight to evaluate potential management options for preventing future recurrences.

7 – Everglades Stormwater Treatment Areas: Understanding the Flow-Way Black Box - Part II

Royal Poinciana

The Everglades Stormwater Treatment Areas (STAs) are a critical component of Everglades restoration. To date, the 57,000 acres of STAs have treated 2.1 million hectare-meter (ha-m) of runoff, reduced the load to the Everglades protection Area by 76%, and reduced the runoff concentrations from 135 to 32 µg/L. More stringent regulatory limits (13 µg/L long-term and 19 µg/L annual flow-weighted mean concentration) require further improvement of the facilities, as well as refinement of operation and management strategies based on scientifically-derived information. The purpose of these sessions is to share knowledge about the STAs and its complex components, and gather ideas on how to further improve STA performance. Attendees who will benefit the most from these sessions are scientists, engineers, modelers, and students who are looking to learn more about large-scale treatment wetlands, including their link to the Everglades Restoration effort, the various mechanisms of phosphorus reduction, the challenges and successes in operating these areas, and current scientific efforts that are underway.

8 – Plant Communities: Ecology and Management

Ibis

This session considers plant dynamics in response to a variety of factors, including hydrologic conditions, exotic invasive species, plant management and sea level rise.

9 – Habitat Links to Wildlife Ecology

Egret

Habitat restoration and management are necessary to sustain populations of wildlife. This session highlights studies linking habitat characteristics and population size of a diverse group of species representing wading birds, amphibians, and crocodilians. Studies included describe the linkage of habitat characteristics to key populations are included addressing links to prey and nesting selection by wading birds, novel restoration approaches to recover habitat quality following P enrichment, abundance and diversity of anurans, and habitat use in crocodiles.

10 – Biocontrol of Weeds in the Greater Everglades Ecosystem, Part 1

Sandpiper

This session will discuss the unique tactics and challenges that comprise a biological control of weeds project from conception to completion. Biological control is a safe, long-term, cost-effective and self-sustaining means of pest control that is especially suitable for vast natural areas such as the Everglades ecosystem. Presentations will cover various aspects of the major weed projects that are being conducted by governmental and university researchers and administrators. Topics will be useful to land managers that wish to obtain government support for weed issues. Researchers will hear about challenging problems and solutions found by fellow ecologists that collectively work on resolving weed issues in the Greater Everglades ecosystem. Agency managers will learn about bottlenecks and opportunities to accelerate the development of beneficial weed agents.

Tuesday, April 18, 2017 | 3:20pm – 5:00pm

11 – Water Storage in Comprehensive Everglades Restoration Plan

Great Cypress

Water storage is essential to meet water supply and environmental demands in South Florida and is a vital component of the Comprehensive Everglades Restoration Plan (CERP). The Greater Everglades water storage capacity has been diminished due to drainage and landscape modifications, depriving the southern Everglades of freshwater during dry years and resulting in regulatory discharges to the Northern Estuaries during wet years. Therefore, storage is essential to replace lost capacity, reduce damaging discharges and supply the water that is needed for both people and the ecosystem. This session focuses on storage options envisioned in the CERP as well as dispersed water management, state-of-the art modeling and uncertainties. As outputs from hydrologic models are used more frequently in planning and decision-making, modeling results comparing cost-benefits of storage alternatives are critical to sound decision-making.

12 – Everglades Stormwater Treatment Areas: Understanding the Flow-Way Black Box - Part III

Royal Poinciana

As mandated by the Everglades Forever Act (EFA), several constructed wetlands, known as the Everglades Stormwater Treatment Areas (STAs) with a total area of 57,000 acres were built on formerly agricultural lands in strategic locations at the interface of the Everglades Agricultural Area (EAA) and the Everglades Protection Area including the Water Conservation Areas (WCAs). These STAs are designed to reduce excess total phosphorus (TP) from surface waters prior to discharging that water into the Everglades Protection Area (EPA). Clearly, the ability of STAs to sequester phosphorus is fundamental to improving water quality in the Everglades Protection Area. This is Part III of three sessions that includes presentations on long-term performance of STAs to reduce phosphorus loads to EPA.

13 – Modeling for Everglades Restoration

Ibis

Computer Modeling is extremely important to Everglades Restoration effort. The main purpose of this session is to show how various modeling tools are used to evaluate or restore America's Everglades. South Florida has multi-agency efforts focusing on the environmental restoration of the Everglades - the largest subtropical wilderness in the United States. Over the past 100 years, population growth, development, the excessive drainage of wetlands, and the changes in water quantity and quality have caused great stress to this fragile ecosystem. 1.7 billion gallons of water that once flowed through the ecosystem now bypass the Everglades and go directly to the ocean or gulf. To restore a more natural pattern of flows and ecologically improve water and habitat management, regional and sub-regional modeling have been done to find answers for the engineers, modelers, hydrologists, researchers and agency managers.

14 – Wildlife Diet and Stress

Egret

This session links dietary and stress responses of alligators, crocodiles, and wading birds to temporal and spatial variation in environmental conditions. Talks in this session draw on measurements of stable isotopes, stress hormones, or direct measures from traditional gut analyses. Study areas collectively span the freshwater Everglades, Florida Bay, and Biscayne Bay.

15 – Biocontrol of Weeds in the Greater Everglades Ecosystem, Part 2

Sandpiper

This session will discuss the unique tactics and challenges that comprise a biological control of weeds project from conception to completion. Biological control is a safe, long-term, cost-effective and self-sustaining means of pest control that is especially suitable for vast natural areas such as the Everglades ecosystem. Presentations will cover various aspects of the major weed projects that are being conducted by governmental and university researchers and administrators. Topics will be useful to land managers that wish to obtain government support for weed issues. Researchers will hear about challenging problems and solutions found by fellow ecologists that collectively work on resolving weed issues in the Greater Everglades ecosystem. Agency managers will learn about bottlenecks and opportunities to accelerate the development of beneficial weed agents.

Wednesday, April 19, 2017 | 10:20am – 12:00noon

16 – Everglades REMAP 2014: Landscape Findings for Mercury, Sulfur, Nutrients, and Vegetation

Great Cypress

The purpose of the session is to update the findings of this program, in which over 1000 marsh locations were sampled from 1995 to 2014. The overarching message is that probabilistic sampling can be used to quantitatively and statistically describe the health of the ecosystem over space and time. The session topic is timely and important to Everglades ecosystem restoration because REMAP, USEPA's Regional Environmental Monitoring and Assessment Program, is the only effort providing a consistent, synoptic, and holistic assessment of the publicly owned freshwater flow-way. Key takeaways include that, since the previous survey in 2005, there is no indication of increasing phosphorus, sulfur and mercury decreased in some ecosystem compartments, and soil thickness remained unchanged. Water and land managers, modelers, and ecologists would benefit by attending, as would those responsible for understanding and controlling phosphorus, mercury and sulfur pollution.

17 – Ecological Resilience and Regime Shifts: Evidence for Human and Climate Impacts on Coastal Ecosystems

Royal Poinciana

Ecological regime shifts are abrupt changes between contrasting, persistent states of a system that are triggered by disturbances such as climatic or hydrologic. The likelihood of regime shifts increases with decreasing ecological resilience. Combined and often synergistic effects of natural and anthropogenic changes make ecosystems more vulnerable to these abrupt shifts, which may move the system to undesired states with reduced ecosystem services. In order to avoid unwanted regime shifts in responses to anticipated future changes, it is essential to gain an understanding of the mechanisms and responses to past ecological shifts over multiple spatial and temporal scales. The goal of this session is to explore advances in our understanding of ecological resilience and the history of regime shifts in coastal and marine ecosystems in South Florida. The objective is to build on existing knowledge in order to explore the best strategies to mitigate or adapt to regime shifts, and to evaluate the range of possible management actions needed for CERP future planning.

18 – RECOVER Five-Year Plan

Ibis

The RECOVER Program is the science behind the Comprehensive Everglades Restoration Plan (CERP) as required by the CERP Programmatic Regulations to determine restoration success and guide Adaptive Management actions. Given the pace of CERP implementation in recent years, new knowledge gained on ecological drivers and stressors in the Everglades and estuaries, and the past ten years of monitoring and development of restoration planning tools, RECOVER has determined the most crucial tasks that must be accomplished to assist CERP implementation between Fiscal Years 2017 and 2021. RECOVER developed a Five Year Plan to conduct this comprehensive review which includes RECOVER involvement in project implementation; reporting CERP's progress in achieving interim goals and targets; integration of and refinement of Everglades science: new conceptual models and analysis of ecological vulnerability; targeted adaptive management to inform CERP progress; and communication of CERP science to maximize its usefulness to decision makers and CERP audiences. This effort will consider assessment of emerging models, sampling techniques, and equipment; evaluations of hypothesis clusters; and resources needed for performance measure revisions.

19 – Ecology, Climate and Restoration Along the Southern Everglades' Boundary

Egret

The C-111 Spreader Canal project and associated water management operations are critical for restoration of the Southern everglades and Florida Bay. Presentations in this session consider ecological dynamics in response to managed and unmanaged drivers, as well as considering the relation of operations and agricultural lands east of Everglades National Park.

20 – Genetic Tools and Environmental DNA (eDNA) Surveillance to Inform Invasive Species Management

Sandpiper

Genetic analysis is an important tool in the study of native and non-species to aid management actions and decisions. Population genetic studies can identify cryptic taxa and provide information on genetic diversity and population structure. Further, these tools can help to delimit source and sink populations and shed light on introduction sources and pathways. Additionally, environmental DNA (eDNA) is a rapidly growing field of noninvasive assessment of invasive and imperiled species for conservation and management applicable to GEER. Environmental DNA uses abiotic samples (e.g. water, soil) to detect shed DNA from animals that are rare or cryptic for range delimitation. During this session, agency managers will gain insight on how these tools can be used to better manage invasive species, for removal efforts, or to aid the assessment of impacts on native fauna. Researchers will be exposed to the cutting-edge research and development of new genetic methods.

Wednesday, April 19, 2017 | 1:20pm – 3:00pm

21 – Periphyton Responses to Water Flow and Nutrient Loading and Implications for Everglades Restoration

Great Cypress

This session aims to convey to water managers, restoration planners, and stakeholders the importance of a comprehensive understanding of periphyton community structure, biogeochemistry, and food web dynamics for the Everglades ecosystem. Periphyton mats are complex systems including inorganic and organic matter, bacteria, algae, and infauna; as such, they are powerful indicators of wetland biogeochemistry, and food web dynamics. Using multiple data sources and lines of evidence, we critically look at various pieces of the Everglades periphyton 'ecological puzzle'. The speakers will present new findings on how periphyton microbial communities respond to freshwater flow and nutrients in terms of nutrient acquisition, community structure, aquatic ecosystem metabolism, and consumer dynamics, alongside perspectives on how contrasting restoration and climate change scenarios may impact Everglades periphyton biogeochemical cycles and food webs.

22 – Groundwater Discharge Along Coasts

Royal Poinciana

The purpose of this session is to provide a greater understanding of how groundwater discharge influences the delivery of nutrients and constituents to the Florida coastline. Groundwater discharging along coastlines can represent fresh-meteoric water, saline groundwater, or a mixture of both fresh and saline waters. Both water-rock and biogeochemical reactions occurring in the coastal aquifer can affect nutrients, trace elements, and carbon sequestration. The discharge of this altered groundwater to the coastal zone can be an important mechanism in the transport of nutrients, constituents, and carbon to the estuarine environments. This session is important for hydrologists and modelers interested in trying to quantify the flux of water, nutrients and constituents to coastal zone. This session is also important for agency managers overseeing the water quality of coastal ecosystems.

23 – Evaluation of Factors Influencing Methylmercury Accumulation in South Florida Marshes

Ibis

Although sulfate-reducing bacteria have been documented as an important vector in methylating mercury (Hg), many other factors have been found to affect the production and bioaccumulation of methylmercury (MeHg). Among these include dissolved organic matter (DOM), basal food chain uptake and biomagnification, atmospheric deposition, and the consortium of methylating bacteria and archaea. As a result, scientists are currently unable to predict the duration and occurrence of Hg methylation hotspots in the Everglades, which in turn poses challenges in controlling MeHg levels. The purpose of this session is to focus on the master factors that control the extent of net Hg methylation in the Everglades, which is a critical issue facing the successful implementation of an Everglades restoration program. The intended audience is scientists, regulators, managers, and environmental groups who are concerned about impacts of mercury in the Greater Everglades System.

24 – Ecological Response to Changing Stressors in Everglades Estuaries

Egret

This session will focus on an array of stressors affecting ecological dynamics in estuaries around the Everglades including the Indian River Lagoon, Caloosahatchee and St. Lucie River Estuaries, Biscayne Bay and Florida Bay.

25 – Landscape Perspectives from the Central Everglades; 14th Annual A.R.M. Loxahatchee NWR Science Workshop

Sandpiper

The purpose of this session is to highlight the role of the central Everglades in the Everglades landscape, and its restoration. This session will focus on landscape connectivity in terms of water quality, hydrology, and use by wildlife. Takeaways from this session will include unique attributes of the central Everglades that provide value to the overall landscape, as well as novel, interdisciplinary methods being integrated into habitat management and restoration. A variety of conference participants will find interest in this session including ecologists, hydrologists, modelers, agency managers and students. However, managers and scientists directly involved in Everglades restoration would gain the most benefit from attending the proposed session. This session is timely and relevant as Everglades ecological and hydrological restoration continues to move forward with the Refuge on the outer fringe of these efforts.

Wednesday, April 19, 2017 | 3:20pm – 5:00pm

26 – Invasive Species in the Restoration Context

Great Cypress

This session will focus on ecosystem- and species-level effects of invasive species populations in the Greater Everglades ecosystem. Biological invasions in South Florida have altered native ecosystems, particularly by altering ecosystem functions and displacing or competing with native species. Without successful control of aggressive invasive plant and animal species, it is unlikely that Everglades restoration objectives can be fully achieved. While restoration scientists must factor biological invasions into restoration goals and planning, there remains uncertainty regarding the predicted magnitude and complexity of biological invasions in the context of Everglades restoration. This session will highlight current research on the effects of invasive species proliferation in the Everglades and stimulate dialog on current research gaps and priorities for research moving forward. Restoration scientists, planners, and agency managers will benefit from the updates on current research and discussions on critical knowledge gaps and future research needs.

27 – Freshwater-Estuarine Gradients in Biogeochemistry

Royal Poinciana

Over the coming decades, the Everglades landscape will be increasingly influenced by hydrologic restoration projects aimed while simultaneously being subjected to sea-level rise (SLR) along the coastal ecotone. Landscape-scale field tests have recently shown that restored flows enhance sediment redistribution, as required for topography restoration and as large-scale landscape models had correctly predicted. These tests, however, also demonstrate strong biological responses and associated feedbacks with flow that were not anticipated by models. The feedbacks between flow and biology suggest that even under low TP, flow could change P loading and therefore biogeochemical processes (e.g., P uptake; OM- and P-transport, loading and accumulation; foodweb dynamics) across the landscape. While these changes will occur in freshwater regions, seawater incursions from press (SLR) and pulse (e.g., storms) type disturbances will increasingly impact wetlands at the marsh-mangrove-estuarine ecotone. Salinity intrusion alters ecosystem processes of plant productivity, soil stability and water and nutrient fluxes along the ecotone. Data syntheses efforts aimed at understanding and predicting these dynamics depend on quantifying the sources and sinks of water, nutrients and OM at very large scales. This session will highlight a number of synthesis approaches – including, among others, mass balance budgets - to address impacts of both restored flow and sea-level rise on water, nutrient and OM fluxes across the freshwater-estuarine gradients. These approaches will also highlight critical uncertainties needed to better predict or anticipate future changes.

28 – Hydrologic and Ecological Forecasting in Support of Natural Resource Planning

Ibis

Ecological forecasting is an emerging field of research aimed at developing predictive models for short- and long-term natural resource decisions. With increasing data streaming from real-time measurement networks, it is judicious to develop techniques that leverage these data for rapid decision-making. In light of growing concern over the frequency and severity of episodic weather events, this session explores methods that use real-time data, including near-term climate forecasts, within ecologically meaningful tools. Techniques presented are supported by advances in information processing, dissemination systems, and data visualization that allow users to interact with timely, decision-oriented data products. Specific applications discussed include coastal overwash predictions in advance of hurricanes (for emergency managers, coastal planners, coastal residents) and water level predictions for species management in the Greater Everglades (for water and natural resource managers).

29 – Assessing Ecosystem Response to Restoration and Water Management

Egret

Hydrologic and vegetation changes are used to assess ecosystem change to former agricultural lands in the Kissimmee River watershed, Loxahatchee Slough in Palm Beach County, emergency highwater operations in Shark River Slough, Corkscrew Swamp Sanctuary in Western Everglades, and Big Cypress National Preserve also in Western Everglades.

30 – Snail Kites & Apple Snails

Sandpiper

The purpose of this session is to provide the Everglades community information on population trends for the endangered Everglade snail kite and the native and invasive apple snails in Florida. Snail kites are an obligate wetland species used as an ecological indicator species to measure the success of Greater Everglades restoration. Snail kite populations declined precipitously before 2010 but since have slowly increased. Explanations for the decline included extreme low and high water events, regulation schedule limitations, decline in prey (native apple snails), and low juvenile survival. Recent population increases appear associated with an invasion of exotic apple snails, not with native snail recovery. This session will provide the latest findings on this indicator species throughout the Greater Everglades. The intended audience is wetland managers, endangered species biologists, ornithologists, conservation biologists, and decision makers working in wetlands systems.

Thursday, April 20, 2017 | 10:20am – 12:00noon

31 – Sea-Level Rise and Everglades Restoration: Coastal Wetland Dynamics and Responses

Great Cypress

This session will present and discuss recent findings that provide insight of how rising sea-level, concurrent with Everglades restoration efforts, will influence coastal wetlands in coming decades. The session includes presentations of results from empirical studies of changing marsh elevation and experimental studies of the effects of salt-water intrusion on processes mediated by marsh plants and microbes, especially carbon and nutrient dynamics. The session will explore understanding of ecological feedbacks associated with sea-level rise and the inland expansion of saline wetlands, the nature of marsh “peat collapse”, and prospects for Everglades restoration to moderate sea-level rise impacts.

32 – Biogeochemical Controls and Effects of Mercury Contamination of the Everglades: An Ecosystem Perspective

Royal Poinciana

Mercury contamination of the Everglades is a well-studied phenomenon, yet due to its significant complexities it remains an active area for research and discovery. The goal of this session is to provide GEER attendees an opportunity to observe a series of linked presentations that will describe the driving factors that yield a wide range of mercury contamination conditions (from minimal to significant) across the Greater Everglades and its toxic effects on wildlife. The topics presented will cover the complete range of driving factors and effects, including: (1) variability in atmospheric deposition; (2) effects of mercury exposure on wading bird reproductive success; (3) spatial and temporal variations in atmospheric deposition and biogeochemical processes affecting bioavailability of mercury for methylation; (4) the effect of sulfate loading on sulfurization of organic matter and trace metal cycling; and, (5) ecosystem wide modeling of spatial and temporal production of methylmercury in response to differing restoration scenarios.

33 – Delivering Climate Change Research to Support Decision Making

Ibis

As climate changes and sea level rise are expected to affect the Everglades in many different ways, researchers and managers must predict impacts and present information to decision makers and stakeholders in an effective manner. The purpose of the proposed session is to present examples of extension outreach from Everglades research and to create a dialogue to identify needs to understand the impacts of projected climate change to the ecosystem. The session will focus on techniques for including extension education in research, both on-going and planned, to engage stakeholders and assist broader audiences in understanding the climate change impacts on the Everglades. Researchers required to include outreach extension in grant proposals and communication staff at governmental and non-governmental institutions would be most likely to have an interest in the content of the session and most benefit by attending the session.

34 – Wetland Forest

Egret

Tropical hardwood hammocks, mangroves and tree islands are critical landscape features providing ecosystem functionality such as sediment trapping, soil accumulation, habitat, biodiversity, and high productivity. This session looks at LIDAR estimates of canopy heights, vegetation dynamics in a mangrove-marsh ecotone, soil accretion and loss on tree islands and successional vegetation trajectories in south Florida.

35 – Human Dimensions

Sandpiper

This session will focus on the multiple interfaces between human and natural systems, including agriculture, urban development, and the introduction of exotic species. The data and information presented will inform Everglades restoration efforts to improve both ecological and economic conditions in South Florida.

Thursday, April 20, 2017 | 1:20pm – 3:00pm

36 – The DPM High-Flow Experiments: Direct Observations to Serve Adaptive Management

Great Cypress

Reintroducing sheetflow to the Everglades ridge-and-slough landscape is a critical step for restoration plans which aim to rehydrate the system and reverse system-wide loss of patterning and microtopography. Started in 2009, the DPM is a landscape-scale experiment, in which experimental sheetflow pulses are generated by culverts that deliver water from WCA3A into WCA3B and produce water velocities resembling historic conditions. Canal backfill treatments coupled with a degraded levee are used evaluate the role of backfilling in preserving low-nutrient sediment redistribution on habitat quality for fisheries. This session highlights the extent to which restoring historic levels of sheetflow has so far restarted the critical process of sediment redistribution and potentially altered water quality and nutrient cycling. The effects of flow and backfilling on fish populations as well as hydrologic and sediment dynamics in canal treatments and surrounding marshes will also be highlighted.

37 – Ecology and Community Dynamics of Invasive Reptiles

Royal Poinciana

This session explores several aspects of invasive animal science and management, including chemical ecology, stable isotopes, activity patterns, data analysis, and early detection/rapid response. The session's focus is on pythons, boas, tegus, and veiled chameleons.

38 – Acoustic Technology for Restoration and Management (Part 1 of 2)

Ibis

In 2007, the Alliance for Coastal Technology held a meeting to evaluate the potential and the limitations of acoustic technology. Today, the identified limitations related to power consumption, storage and data management have been overcome. Advances in passive acoustic technology allow it to be used for ecosystem monitoring. Advances in active acoustic technology allow us to track animals at finer spatiotemporal resolutions and with higher accuracy. Thus we are now able to link animal movement and habitat use to key environmental drivers, with implications for managing, conserving and restoring ecosystems and their biodiversity. This session highlights acoustic research and management in Everglades' terrestrial and marine ecosystems and in other coastal regions. The target audience includes engineers, hydrologists, researchers and resource managers who will learn about acoustic monitoring techniques and data processing with examples and implications for management.

39 – Marl Prairie Landscape: Its Ecology and Importance in Everglades Restoration

Egret

Everglades marl prairies are a mosaic of seasonally flooded, short hydroperiod wetlands with calcitic marl substrates in the Southern Everglades. These wetlands are the habitat for a federally listed endangered species, Cape Sable seaside sparrows (CSSS; Ammodramus maritimus mirabilis), and have been the focus of Everglades restoration efforts centered around the CSSS for two decades. The purpose of this session is to highlight several different physical and biological components of this critical landscape with respect to both present and future restoration activities. This session covers diverse biological communities and their ecology, which can serve as indicators of restoration and guide the course of future efforts. The session will stimulate participants to consider whether the single species-centered restoration activities that have been used to date serve to holistically restore the marl prairie ecosystem, along with its diverse biological communities and ecosystem processes.

40 – Sea Level Rise and Saltwater Intrusion: Biogeochemistry and Water Quality

Sandpiper

Recent estimates of future eustatic sea-level rise vary from 20 to 70 cm by the year 2100. These projected increases are likely to have enormous impacts on coastal wetlands worldwide inundating south Florida ecosystems. In the Florida Everglades, salt water intrusion can be caused by sea-level rise and associated hydrologic changes. This can result in salinity and changes in physical, chemical and biological properties of soils and shift in biotic communities. In this session a series of presentations will address emerging issues in biogeochemistry and water quality of the Everglades as related to the restoration strategies.

Thursday, April 20, 2017 | 3:20pm – 5:00pm

41 – System-wide Modeling to Predict Ecological Outcomes of Restoration

Great Cypress

The Everglades is valued for freshwater and ecological resources that support a highly valued combination of densely vegetated marsh and tree island habitats interspersed with well-connected deepwater sloughs that maintain pathways for fish migration and feeding areas for wading birds. A century of water management has substantially changed hydroperiods and altered the direction and velocity of water flow, vegetation community composition, ground surface (due to peat subsidence), and threatens water quality. This session examines the latest results from integrated analyses of flow restoration and predicted ecological outcomes of restoration. The session brings together key scientists from working groups such as the Central Everglades Planning Process (CEPP) and the Synthesis of Everglades Restoration and Ecosystem Services (SERES) teams with the aim to specify and discuss the future ecological outcomes of restoration. Presentations emphasize predictions of the level of Everglades ecosystem functionality achieved for a given investment in restoration across a spectrum of scenarios ranging from no plan to full decompartmentalization.

42 – Integrating Science and Management for Controlling Invasive Species

Royal Poinciana

Millions of dollars are spent annually in the Everglades to monitor and control the spread of exotics such as Brazilian pepper, melaleuca, Old World climbing fern, and Burmese python. The purpose of this session is to introduce scientists and managers to the application of decision science to help direct more cost-effective control strategies for invasive species. Four case studies will demonstrate how decision problems in invasive species control can be framed to make them amenable to formal analysis. These case studies will be followed by an articulation of principles that can help ensure science and management are well integrated in efforts to control invasive species. The utility of decision science ultimately depends on extensive collaboration, in which managers specify their objectives, constraints, and possible control actions, and scientists help predict the consequences of alternative choices in terms that are relevant to the manager's objectives.

43 – Acoustic Technology for Restoration and Management (Part 2 of 2)

Ibis

In 2007, the Alliance for Coastal Technology held a meeting to evaluate the potential and the limitations of acoustic technology. Today, the identified limitations related to power consumption, storage and data management have been overcome. Advances in passive acoustic technology allow it to be used for ecosystem monitoring. Advances in active acoustic technology allow us to track animals at finer spatiotemporal resolutions and with higher accuracy. Thus we are now able to link animal movement and habitat use to key environmental drivers, with implications for managing, conserving and restoring ecosystems and their biodiversity. This session highlights acoustic research and management in Everglades' terrestrial and marine ecosystems and in other coastal regions. The target audience includes engineers, hydrologists, researchers and resource managers who will learn about acoustic monitoring techniques and data processing with examples and implications for management.

44 – Integrated Phosphorus Management

Egret

Efforts to reduce the contribution of phosphorus to the South Florida Ecosystems are critical to state and federal programs for restoration. This session will discuss modeling efforts used to select best management practices (BMPs) and inflow into wetlands, hydrological controls of phosphorous in Stormwater Treatment Areas (STAs), and sustainable phosphorous management in the Everglades Agricultural Area (EAA).

45 – Biscayne Bay

Sandpiper

Biscayne Bay is undergoing ecological restoration as part of Regional Restoration Coordination and the Comprehensive Everglades Restoration Plan. This work has been reflected in changes in the coastal wetlands and downstream bay. Improvements and changes are important feedback to managers and engineers as we move forward on project design and operations.

Agenda-at-a-Glance

Monday, April 17, 2017

9:00am–10:00am	Workshop Attendee Arrival and Registration
10:00am–5:00pm	OPTIONAL Pre-Conference Workshops
4:00pm–7:00pm	Conference Registration Open
4:00pm–7:00pm	Exhibiting Sponsors and Poster Session One Presenters Install Displays *(Poster Session One presenters will remove displays on Wednesday during the 10:00am-10:20am refreshment break.* *Poster Session Two presenters will install displays on Wednesday during the 12noon-1:20pm lunch break.)*
5:00pm–7:00pm	Informal Networking Social on Breeze's Terrace
IMPROMPTU MEETINGS: If you want to take advantage of having multiple colleagues gathered in one location to hold a private meeting, a small room (with a maximum capacity of 22 U-shape) is available throughout the conference on a first-come, first-served basis. A sign-up sheet will be posted on the conference message board in the Conference Center foyer near the registration desk.	

Tuesday, April 18, 2017

7:30am–8:30am	Morning Refreshments in Poster & Sponsor Display Area
8:30am–10:00am	**Opening Plenary Session**
10:20am–5:00pm	**Concurrent Sessions**
12noon–1:20pm	Lunch Buffet Provided
5:00pm–7:15pm	**Poster Session One & Networking Reception**

Wednesday, April 19, 2017

7:30am–8:30am	Morning Refreshments in Poster & Sponsor Display Area
8:30am–10:00am	**Plenary Session**
10:00am–10:20am	Poster Session One presenters remove posters
10:20am–5:00pm	**Concurrent Sessions**
12noon–1:20pm	Lunch Buffet Provided *(Poster Session Two presenters install posters)*
5:00pm	Evening on Own

Thursday, April 20, 2017

7:30am–8:00am	Morning Refreshments in Poster & Sponsor Display Area
8:00am–10:15am	**Poster Session Two & Networking**
10:20am–5:00pm	**Concurrent Sessions**
12noon–1:20pm	Lunch Buffet Provided
5:00pm–6:00pm	**Networking Reception**
6:00pm–7:00pm	**Closing Keynote Address**
7:00pm–9:00pm	Poster and Exhibitor Move-out

Daily mid-day and afternoon refreshment breaks will also be provided in the Poster & Sponsor Display Area.

GEER 2017 Detailed Agenda

	Monday, April 17, 2017
9am	**Workshop Attendee Arrival and Registration** *[Conference Center Wing]*
10:00am-5:00pm	**Optional Pre-Conference Workshops** **Water, Energy and Carbon Cycling Within the Greater Everglades Ecosystem** *[Ibis]* ***-AND-*** **Enhancing Engagement: Skills & Strategies to Involve Stakeholders in Everglades Restoration Efforts** *[Sandpiper]*
4pm - 7pm	**Main Conference Registration Open**
4:00pm-7:00pm	**Exhibiting Sponsors and Poster Session One Presenters Install Displays** *(Poster Session One presenters will remove displays on Wednesday during the 10:00am-10:20am refreshment break. Poster Session Two presenters will install displays on Wednesday during the 12noon-1:20pm lunch break.)*
5:00pm - 7:00pm	**Informal Networking Social on Breeze's Terrace** *(Please plan to arrive in time to join us!)*

	Tuesday, April 18, 2017
7:30am-5:00pm	**Conference Registration Open**
7:30am-8:30am	**Morning Refreshments in Poster & Sponsor Display Area**
8:30am-10:00am	**Opening Plenary Session: Bridging Science to Management in Large-scale Ecosystem Restoration Programs** *[Great Cypress & Royal Poinciana]* **Opening Remarks - Conference Chair** **Nick Aumen,** Regional Science Advisor - South Florida, U.S. Geological Survey, Davie, FL **Welcome and Introductions** **Jack Payne,** Senior Vice President for Agriculture and Natural Resources, University of Florida/IFAS, Gainesville, FL **Presenters** **Mike Chotkowski,** San Francisco Bay-Delta Science Coordinator, U.S. Geological Survey, Sacramento, CA ***"Cultivating Reproducible Science and Social Capital in Major Science Enterprises"*** **Stephen Brandt,** Professor, Oregon State University, Corvallis, OR ***"Ecosystem Forecasting: Bridging Science to Management"***
10:00am-10:20am	**AM Refreshment Break in Poster & Sponsor Display Area**

Tuesday, April 18, 2017

Concurrent Sessions – 10:20am - 12:00noon

	Session 1	Session 2	Session 3	Session 4	Session 5
	Great Cypress	Royal Poinciana	Ibis	Egret	Sandpiper
	The Utility of Strategic Communication to the GEER Community of Practice	**Everglades Stormwater Treatment Areas: Understanding the Flow-Way Black Box - Part I**	**Tools in Support of Restoration and Invasive Species Science and Management**	**Controls on Wildlife Population Dynamics**	**Applying Innovative Modeling Approaches to Protect and Restore the Greater Everglades**
10:20am	**Matt Harwell**	**Delia Ivanoff**	**Joel Trexler**	**Rolando Santos**	**Donald DeAngelis**
	Introduction	Introduction	Introduction	Introduction	Introduction
10:30am	**Matt Harwell** The Science of Strategic Communication	**Delia Ivanoff** Current State of the Stormwater Treatment Areas	**David Lagomasino** Stick in the Mud: Mangrove Loss in South Florida	**Simona Picardi** Tracking Large-Scale Movements of Wood Stork in the Greater Everglades Ecosystem	**William Harford** Forecasting Inshore Red Tide Blooms Using Recent Past Offshore Conditions on the West Florida Shelf
10:45am	**Stephanie Johnson** Strategic Communication of the National Academies of Sciences, Engineering, and Medicine: Everglades Studies and Beyond	**Rupesh Bhomia** Nutrient Storages in the Everglades Stormwater Treatment Areas	**Hannah Cooper** Fusing LiDAR with RTK GPS Using Random Forest Regression Shows Promising for DEMs of Mangrove and Sawgrass Soil Heights in Florida's Coastal Everglades	**Michelle Petersen** Effect of Water-Level Fluctuations on Resource Selection of Wading Birds	**Steven Bartell** Application of the Comprehensive Aquatic System Model (CASM) in Support of Ecosystem Restoration
11:00am	**Todd Hopkins** Using Strategic Communication to Advance the Mission of the Landscape Conservation Cooperatives	**Mike Jerauld** Phosphorus Flux in the Everglades Stormwater Treatment Areas	**Daina Stoutenburg** A New Eye in the Sky: A Case Study on 3D Modeling Everglades Restoration Projects With Drone Imagery	**Dale Gawlik** Evolving Views of Food-Limitation in Wading Birds: Differing Implications of Prey and Foraging Habitat Availability	**Simeon Yurek** Simulating a Classic Study of Prey Concentration in the Everglades in Support of Long Term Decision Strategy
11:15am	**Patti Gorman** Strategic Communication of REstoration COordination VERification (RECOVER) Science for the Comprehensive Everglades Restoration Program	**Serge Thomas** Settling and Entrainment Properties of Stormwater Treatment Area Particulates	**DeEtta Mills** "Agri-Dogs": Using Canines for Earlier Detection of Laurel Wilt Disease Affecting Avocado Trees *(Persea Americana)* in South Florida	**Jason Bosley** Long-Term Changes in Territory Use: A Markovian Approach to Modeling Bald Eagle Dynamics in Florida Bay	**Bo Zhang** Simulating the Impact of Biological Control on an Invasive Plant by Using an Individual Based Model (JABOWA)
11:30am	**Shannon Estenoz** Strategic Communication at the South Florida Ecosystem Restoration Task Force	**Manuel Zamorano** Historical Performance of the STA-3/4 Periphyton-based Stormwater Treatment Area	**Rebekah Wallace** Citizen Science and IveGot1	**Rolando Santos** Integration of Fishery-Dependent Data and Local-Ecological Knowledge to Characterize Bonefish *Albula Vulpes* Population Trends in Florida Bay	**Eric Swain** Numerical Model for Short-Term Forecasting of Everglades Hydrology Using a Current Conditions Water-Level Network
11:45am	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion
12noon-1:20pm	**Lunch Buffet Provided**				

Tuesday, April 18, 2017

Concurrent Sessions – 1:20pm - 3:00pm

	Session 6	Session 7	Session 8	Session 9	Session 10
	Great Cypress	Royal Poinciana	Ibis	Egret	Sandpiper
	Status, Causes, and Consequences of Ongoing, Large-Scale Seagrass Die-off in Florida Bay	**Everglades Stormwater Treatment Areas: Understanding the Flow-Way Black Box - Part II**	**Plant Communities: Ecology and Management**	**Habitat Links to Wildlife Ecology**	**Biocontrol of Weeds in the Greater Everglades Ecosystem, Part 1**
1:20pm	**Amanda McDonald**	**Delia Ivanoff**	**Sue Newman**	**Mark Cook**	**LeRoy Rodgers**
	Introduction	Introduction	Introduction	Introduction	Introduction
1:30pm	**James Fourqurean** Dieoff Déjà Vu – The Late 1980's Seagrass Dieoff in Florida Bay Looked Eerily Similar to Current Events	**Odi Villapando** Water Quality Along Inflow to Outflow Gradient of the Everglades Stormwater Treatment Areas	**Junbin Zhao** Photosynthetic Activity of C3 and C4 Graminoids in Response to Water Table Change in a Short-Hydroperiod Wetland of the Florida Everglades	**Emilie Kohler** Prey Selection by the Little Blue Heron *(Egretta Caerulea)* in Great White Heron National Wildlife Refuge	**Carey Minteer** Determining the Feasibility of Biological Control of a Weed Target
1:45pm	**Christopher Kavanagh** Florida Bay 2015 Seagrass Die-Off: Extent and Characteristics	**Kanika Inglett** Microbial Dynamics in the Stormwater Treatment Areas	**Helen Hammond** Survey for *Lygodium Microphyllum* and Other Invasive Exotic Species on Tree Islands in Water Conservation Area 3	**Edwin Everham** Anurans as Indicators of Landscape Change in Southwest Florida	**Rosalind James** USDA-ARS National Program Overview of Biocontrol of Weeds
2:00pm	**Margaret Hall** Long-Term Changes in Florida Bay Seagrass Communities: Tales of Resilience and Vulnerability	**Jill King** Role of Vegetation on Phosphorus Reduction in the Everglades Stormwater Treatment Areas	**Michael Manna** Honing the Blade of Active Marsh Improvement: Is Sequence Important for Controlling Cattail for Rehabilitation of Ridges and Sloughs?	**Jennifer Nestler** Assessing Habitat Use in the American Crocodile *(Crocodylus Acutus)*, a Threatened Species in the Greater Everglades Ecosystem	**Greg Wheeler** Biocontrol of Weeds in the Greater Everglades Ecosystem: Process, Challenges and Paths Forward
2:15pm	**Paul Carlson** Physical, Chemical, and Biological Processes Cause Seagrass Mortality in Florida Bay	**Kevin Grace** Effect of Limerock Substrates on the STA Water Quality and Vegetation Characteristics	**Michael Duever** Considerations for Controlling Willow Invasions of Marshes	**Jenna May** The Effects of Colony Structure and Nest Position on the Nesting Success of Wading Birds	**Bob Tichenor** Why Has it Taken So Long to Permit New Weed Biocontrol Agents?
2:30pm	**Christopher Kelble** Seeing the Forest through the Dead Seagrass: Response of Florida Bay Fish Species to Seagrass Dieoffs, Salinity, and Other Environmental Factors	**Stefan Gerber** Data Integration and Synthesis Framework for Understanding the Phosphorus Cycling and Reduction Mechanisms in STA Flow-ways	**Donny Smoak** Will Future Soil Accretion in the Mangrove Forest Keep Up with Sea Level Rise?	**Mark Cook** Investigating Active Marsh Improvement Approaches for Restoring Water Bird Habitat in the P-Enriched Everglades	**Eric Rohrig** Interagency Coordination for the Mass Production and Distribution of Biological Control Agents
2:45pm	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion
3:00pm-3:20pm	**PM Refreshment Break in Poster & Sponsor Display Area**				

	Tuesday, April 18, 2017				
	Concurrent Sessions – 3:20pm - 5:00pm				
	Session 11	**Session 12**	**Session 13**	**Session 14**	**Session 15**
	Great Cypress	**Royal Poinciana**	**Ibis**	**Egret**	**Sandpiper**
	Water Storage in Comprehensive Everglades Restoration Plan	**Everglades Stormwater Treatment Areas: Understanding the Flow-Way Black Box - Part III**	**Modeling for Everglades Restoration**	**Wildlife Diet and Stress**	**Biocontrol of Weeds in the Greater Everglades Ecosystem, Part 2**
3:20pm	**Thomas Van Lent**	**Rupesh Bhomia**	**Fahmida Khatun**	**Betsy Evans**	**LeRoy Rodgers**
	Introduction	**Introduction**	**Introduction**	**Introduction**	**Introduction**
3:30pm	**Wendy Graham** Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades	**Larry Fink** An Analysis, Integration and Synthesis for Enhancing Nutrient Removal by Stormwater Treatment Areas for Everglades Restoration	**Jaime Graulau-Santiago** Modeling of the PSRP South West Flood Protection Features in the Gridded Surface Subsurface Hydrologic Analysis Tool	**Ashley Jackson** Diet Shift of Egrets in Response to Environmental Change	**Ellen Lake** Confirming Safety: Ecological Host-range and Monitoring for Spillover in Weed Biological Control
3:45pm	**Robert Johnson** Water Storage Features in the Comprehensive Everglades Restoration Plan (CERP) – Original Goals and Current Status	**William Gao** Stormwater Treatment Area Performance Prediction using Artificial Neural Networks	**Michael Brown** Use of a Natural System Regional Simulation Model in Restoration Project Planning	**Mathew Denton** Stable Isotope Ecology of American Alligators within the Greater Everglades	**Melissa Smith** Biotic Resistance in Weed Biological Control
4:00pm	**Rajendra Paudel** A Comparison of the Benefits of Northern and Southern Everglades Storage	**Kristin Vaughan** Evaluation of Inundation Depth and Duration Threshold for Cattail Sustainability – In Situ Study	**Fahmida Khatun** Evaluation of Options for Sending More Water to Florida Bay via Taylor Slough Using Regional Simulation Model for the Everglades and Lower East Coast	**Marisa Martinez** Prey Availability of Wading Birds in Intertidal Systems	**Phil Tipping** Indirect Effects – Food Webs in Biological Control
4:15pm	**Sanjay Shukla** Water Storage and Treatment Services from Agricultural Lands in the Northern Everglades	**Wasantha Lal** Mapping Vegetation Properties and Flow Patterns in Stormwater Treatment Areas (STAs) Using Wave Tests	**Kiren Bahm** Effects of Restoration Alternatives on Stages and Flows in the Southern Everglades, Using the Mike Marsh Model of Everglades National Park (M3ENP)	**Michiko Squires** Responses of American Crocodiles to Environmental Conditions at a Power Plant Site in Southern Florida	**Lyn Gettys** Integrated Weed Control
4:30pm	**Q&A - Discussion**	**Forrest Dierberg** Soil Accrual and Phosphorus Retention in a Flow-Way Dominated By Submerged Aquatic Vegetation within an Everglades Treatment Area: A Longitudinal Study	**Christopher Buzzelli** Predicting the Responses of Seagrass and Oyster Habitats to Changes in Water Management	**Betsy Evans** Dietary Flexibility of Wood Storks in Response to Human-Induced Landscape Change in South Florida	**Min Rayamajhi** Ecosystem Recovery Following Implementation of Weed Biological Controls; *Melaleuca quinquenervia*
4:45pm		**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**
5:00pm-7:15pm	**Poster Session One & Networking Reception** *(To allow for greater interaction and ease of discussion, presenters at ODD numbered boards are asked to stand at their posters from 5:30-6:15pm. There will be a break for poster presenters to switch and a prize drawing from 6:15-6:30pm. Presenters at EVEN numbered boards are asked to stand at their posters from 6:30-7:15pm.)*				

	Wednesday, April 19, 2017
7:30am-5:00pm	**Conference Registration Open**
7:30am-8:30am	**Morning Refreshments in Poster & Sponsor Display Area**
8:30am-10:00am	**Plenary Session:** **Design, Innovation, and Governance (DIG): Solutions for Everglades Restoration** *[Great Cypress & Royal Poinciana]* **Session Organizers:** **Fred Sklar,** Director and Section Administrator, Everglades Systems Assessment Section, South Florida Water Management District, West Palm Beach, FL *–and–* **Nick Aumen,** Regional Science Advisor – South Florida, U.S. Geological Survey; GEER 2017 Chair **“Sustainability” — Dan Childers,** Professor, Arizona State University, Tempe, AZ **“Keeping it Real” — Stephanie Johnson,** Senior Program Officer, National Academy of Sciences, Washington, DC **“The Allegory of the Patient” — Fred Sklar,** Director and Section Administrator, Everglades Systems Assessment (ESA) Section, South Florida Water Management District, West Palm Beach, FL **“Bird Brains” — Peter Frederick,** Research Professor, University of Florida/IFAS, Gainesville, FL **“The Value of Citizen Science” — Jennifer Rehage,** Assistant Professor, Florida International University, Miami, FL **“Resource Governance” — The Honorable Robert “Bob” Graham,** former Florida Governor and United States Senator, Miami Lakes, FL
10:00am-10:20am	**AM Refreshment Break in Poster & Sponsor Display Area** *(ATTENTION Poster Session One Presenters: Please remove your poster during this refreshment break.)*

Wednesday, April 19, 2017

Concurrent Sessions – 10:20am - 12:00noon

	Session 16	Session 17	Session 18	Session 19	Session 20
	Great Cypress	**Royal Poinciana**	**Ibis**	**Egret**	**Sandpiper**
	Everglades REMAP 2014: Landscape Findings for Mercury, Sulfur, Nutrients, and Vegetation	**Ecological Resilience and Regime Shifts: Evidence for Human and Climate Impacts on Coastal Ecosystems**	**RECOVER Five-Year Plan**	**Ecology, Climate and Restoration Along the Southern Everglades' Boundary**	**Genetic Tools and Environmental DNA (eDNA) Surveillance to Inform Invasive Species Management**
10:20am	**Peter Kalla & Dan Scheidt**	**Anna Wachnicka**	**April Patterson**	**Amanda McDonald**	**Margaret Hunter**
	Introduction	**Introduction**	**Introduction**	**Introduction**	**Introduction**
10:30am	**Jennifer Richards** The Landscape Context for REMAP IV: Plant Community Distribution and Cover Derived from Vegetation Mapped with WorldView2 Satellite Data	**Anna Wachnicka** Detecting Signs of Impending Large-Scale Ecological Regime Shifts in South Florida Estuaries Through the Lens of Paleoecology	**Glenn Landers** New Climate Change Information for Consideration in Enhancing Everglades Restoration Climate Preparedness and Resilience	**Tom Frankovich** Light Attenuation in Estuarine Mangrove Lakes	**Sophia Orzechowski** Are Burmese Pythons Attracted to Tree Islands with Wading Bird Colonies? Using eDNA to Determine Occupancy Rates of Pythons at Wading Bird Breeding Sites in the Everglades
10:45am	**Leonard Scinto** Spatial Distribution in Everglades Nutrient Budgets and Their Effects on Biogeochemical Processes	**Debra Willard** Long-term Patterns of Coastal Response to Changing Land Use and Climate: Examples from the Atlantic and Gulf Coastal Plains	**Jenna May** Integration and Refinement of Everglades Science: New Conceptual Models and Analysis of Ecological Vulnerability	**Peter Frezza** Response of the Sav Community in the Coastal Mangrove Zone of Florida Bay to Record Rainfall and Increased Freshwater Flow	**Joshua Finn** Environmental DNA (eDNA) and Environmental RNA (eRNA) Markers for Invasive Species Detection
11:00am	**Guangliang Liu** Distribution of Mercury Species in the Everglades: A Geochemical Perspective and Implications on Mercury Bioaccumulation	**Lynn Wingard** Centennial to Millennial Scale Perspective on the Role of Salinity in Ecological Regime Shifts in South Florida's Estuarine Ecosystems	**Andy LoSchiavo** Targeted Adaptive Management to Inform CERP Progress	**Michelle Robinson** Unique Hydrologic Events during the 2015-16 Hydrologic Year Provide Further Incite into the Effectiveness of the C-111 Spreader Canal Western Project	**Edgardo Diaz-Ferguson** Molecular Characterization of Arthur R. Marshall Loxahatchee National Wildlife Refuge Fish Community
11:15am	**Yong Cai** Decadal Variations of Mercury in Mosquitofish in the Everglades and Relation to Changes in Atmospheric Hg Deposition and Ecosystem Alteration	**Michael Savarese** Shifting Baselines in Southwest Florida's Oyster Populations: The Effects of Overharvesting by Native Americans and the Implications for Future Management and Restoration of Oyster Reefs	**Gretchen Ehlinger** RECOVER's Role in CERP Implementation	**Michael Kline** Effects of a US-1 Mitigation Effort on Hydrologic Conditions and SAV Abundance	**Jared Wood** Insights into the Introduction Histories of the Nile Monitor *(Varanus Niloticus)* and Argentine Black-and-White Tegu *(Salvator Merianae)* in Florida via Next Generation Sequencing and Population Genetic Analysis
11:30am	**Peter Kalla** Everglades R-EMAP Phase IV 2014: Implications for Mercury Methylation and Bioaccumulation	**Laurel Collins** Historical Perspective on the Ecosystem Health of Florida Bay - A Foraminiferal Proxy for Seagrass Abundance	**Agnes McLean** Integration and Refinement of Everglades Science: A Relook at CERP Interim Goals and Targets	**Meijing Zhang** Investigate Spatial Differences in Flooding Risk Associate with Rainfall and Canal Water Stage in the C-111 Agricultural Basin	**Kelly Williams** Finding NiMo: eDNA Detection of Nile Monitors *(Varanus Niloticus)*
11:45am	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**
12noon-1:20pm	**Lunch Buffet Provided** *(ATTENTION Poster Session Two Presenters: Please install your poster during this lunch break.)*				

	Wednesday, April 19, 2017				
	Concurrent Sessions – 1:20pm - 3:00pm				
	Session 21	**Session 22**	**Session 23**	**Session 24**	**Session 25**
	Great Cypress	**Royal Poinciana**	**Ibis**	**Egret**	**Sandpiper**
	Periphyton Responses to Water Flow and Nutrient Loading and Implications for Everglades Restoration	**Groundwater Discharge Along Coasts**	**Evaluation of Factors Influencing Methylmercury Accumulation in South Florida Marshes**	**Ecological Response to Changing Stressors in Everglades Estuaries**	**Landscape Perspectives from the Central Everglades; 14th Annual A.R.M. Loxahatchee NWR Science Workshop**
1:20pm	**Luca Marazzi**	**Rene Price**	**Forrest Dierberg & Paul Julian**	**Andre Daniels**	**Steven Henry**
	Introduction	**Introduction**	**Introduction**	**Introduction**	**Introduction**
1:30pm	**Barry Rosen** Why the Primary Producers (Algae and Cyanobacteria) are the Key Early Responders to Nutrient and Water Flow Changes in the Everglades	**Rene Price** Significance of Groundwater Discharge to Coastal Zones	**Binhe Gu** High Biotic Mercury in South Florida Wetlands: Fish Trophic Position and Wading Bird Redistribution	**Christian Avila** A Review of Seagrass Losses and Algal Blooms in Biscayne Bay	**Rebekah Gibble** Unique Role of the A.R.M. Loxahatchee National Wildlife Refuge in the Greater Everglades Landscape
1:45pm	**Sue Newman** Effects of Increased Flow and Associated Phosphorus Loads on Microbial Responses	**Hilary Flower** Rapid and Intense Phosphate Desorption Kinetics When Saltwater Intrudes into Carbonate Rock	**Paul Julian** Limiting Factors in Mercury Methylation Hotspot Development: The Tangled Web	**Galia Varona** Development, Persistence, and Impacts of a Decade Long Macroalgal Bloom in Biscayne Bay	**Yong-shan Wan** Hydrologic Drivers of Ecological Processes in the Central Everglades
2:00pm	**Evelyn Gaiser** Water Quality Implications of Hydrologic Restoration Alternatives in the Florida Everglades, USA: A Periphyton Perspective	**Christopher Smith** The Role of Tides in Groundwater-Surface Water Exchange in the Shark River, Florida Coastal Everglades, Florida	**Curtis Pollman** Biogeochemical Variables Driving Temporal Dynamics and Spatial Variability in Mercury Bioaccumulation in *Gambusia* in the Everglades - A Model Analysis Using R-EMAP	**Lauren Kircher** Changes in Salinity in the St. Lucie Estuary and Implication for Snook Movement Patterns	**Donatto Surratt** Development of a Simple Vegetation Index to Monitor Habitat Impacts
2:15pm	**Erik Tate-Boldt** The Influence of Altered Flow Regimes on Aquatic Ecosystem Metabolism in an Everglades Marsh	**Shimelis Dessu** Taylor Slough Groundwater Discharge Simulation Using Sutra	**Tom DeBusk** Investigation of Factors that Contribute to Variations in Mosquitofish *(Gambusia holbrooki)* Mercury Concentrations in Water Conservation Area 2A	**Amanda Kahn Dickens** St. Lucie Estuary and Indian River Lagoon: Examining Seagrass Species Composition Coupled with Flow Rates and Salinity	**Andrew Eastwick** Invasive Exotic Species in the Northern Everglades: A Regional Perspective
2:30pm	**Sarah Bornhoeft** Influence of an Experimental Sheet Flow Regime on Aquatic Food Webs of the Central Everglades	**Joshua Allen** Hydrochemical Conditions of Two Estuarine Mangrove Lake Drainage Systems in the Everglades	**Andrew Ogram** Phylogenetic Distribution of Mercury Methylators in the Water Conservation Areas	**Andre Daniels** Hypersalinity Impacts on Seagrass and Molluscan Communities in Western Florida Bay	**Steve Traxler** Role of Landscape Conservation Cooperatives (LCCs) in Everglades Restoration
2:45pm	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**
3:00pm-3:20pm	**PM Refreshment Break in Poster & Sponsor Display Area**				

Wednesday, April 19, 2017

Concurrent Sessions – 3:20pm - 5:00pm

	Session 26	Session 27	Session 28	Session 29	Session 30
	Great Cypress	**Royal Poinciana**	**Ibis**	**Egret**	**Sandpiper**
	Invasive Species in the Restoration Context	**Freshwater-Estuarine Gradients in Biogeochemistry**	**Hydrologic and Ecological Forecasting in Support of Natural Resource Planning**	**Assessing Ecosystem Response to Restoration and Water Management**	**Snail Kites & Apple Snails**
3:20pm	**Jon Lane**	**John Kominoski**	**James Beerens**	**Michael Simmons**	**Stephanie Romañach & Paul Gray**
	Introduction	**Introduction**	**Introduction**	**Introduction**	**Introduction**
3:30pm	**Robert McCleery** Burmese Pythons and Urbanization Shape the Meso-Mammal Community Across the Everglades	**Colin Saunders** Flow Impacts on P and Organic Matter Cycling in the Ridge and Slough: Lessons from Landscape Budgets in the Decomp Physical Model and Shark River Slough, Everglades National Park	**Leonard Pearlstine** Revisiting Everglades Species Ecological Models for Planning and Assessment	**Gregory Sonnier** Assessing the Success of Hydrological Restoration in Two Conservation Easements within the Headwaters of the Everglades	**Kenneth Meyer** Movements of Snail Kites *(Rostrhamus sociabilis)* Tracked by Satellite, 2007-2016: Habitat Associations, Multiple Residence Areas, and Sustainable Management of a Range-Wide Habitat Network
3:45pm	**Jeffrey Kline** Expansion and Dominance of Non-Native Fish Populations Across Everglades National Park	**Greg Starr** Seasonal Patterns in Energy Partitioning of Everglades Freshwater Marshes	**James Beerens** The Sensitivity of Everglades Species Model Predictions Across Near-Term Depth Forecasts	**Jennifer Chastant** Preserving the South Florida Ecosystem Mosaic: Palm Beach County Natural Areas with Emphasis on Acreage Pines Natural Area	**Robert Fletcher** Consequences of Hydrology for Reproduction by Snail Kites: A 20-Year Investigation
4:00pm	**Joel Trexler** Non-Native Fish and Everglades Restoration: An Unexpected Challenge to Restoring An Iconic Ecosystem	**Lu Zhai** Application of a Dual-Isotope Model in the Shark River Slough Watershed: Separating Increases in Salinity Due to Saltwater Intrusion from that Due to Evaporation	**Joseph Long** An Operational Forecast Model for Coastal Water Levels	**Sean Sculley** Response to the WCA-3A High Water Emergency February – May 2016	**Ellen Robertson** A Conservation Genetic Assessment of the Florida Snail Kite
4:15pm	**Marsha Ward** Tree Island Restoration in the Florida Everglades: Reversing the Exotic Plant Invasion	**Rudolf Jaffé** Tracers of Organic Matter Transport in Flowing Everglades Wetlands, from Marsh to Estuary	**Mark McKelvy** Designing a Software Framework for Hydrologic Forecasts and Modeling Species Responses	**Shawn Clem** Recent Hydrologic Change in a Rainfall-Driven Western Everglades Swamp	**Brent Bachelder** Enhance It and They Will Come - Everglade Snail Kite Utilization of Habitat Management Areas on Lake Okeechobee
4:30pm	**Michael Rochford** Relationships Between Invasive Wildlife and Ecosystem Restoration in the Florida Everglades	**John Kominoski** Shifting Long-term Biogeochemical Baselines: Enhanced Marine Connectivity Increases Nutrient Availability in Coastal Wetland Ecosystems	**Stephanie Romañach** Managing Multiple Species with Conflicting Needs in the Everglades	**Bob Sobczak** WERP: How an Obsolete Levee and an Abandoned Jetport Hold the Key to a Rain-Driven Swamp	**Jennifer Bernatis** Occurrence of Apple Snails Beyond the Shallow Marsh
4:45pm	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**
5:00pm	**Evening On Own**				

Thursday, April 20, 2017

7:30am-5:00pm	**Conference Registration Open**				
7:30am-8:00am	**Morning Refreshments in Poster & Sponsor Display Area**				
8:00am-10:15am	**Poster Session Two & Networking** *(To allow for greater interaction and ease of discussion, presenters at ODD numbered boards are asked to stand at their posters from 8:30-9:15am. There will be a break for poster presenters to switch and a prize drawing from 9:15-9:30am. Presenters at EVEN numbered boards are asked to stand at their posters from 9:30-10:15am.)*				
	Concurrent Sessions – 10:20am - 12:00noon				
	Session 31	**Session 32**	**Session 33**	**Session 34**	**Session 35**
	Great Cypress	**Royal Poinciana**	**Ibis**	**Egret**	**Sandpiper**
	Sea-Level Rise and Everglades Restoration: Coastal Wetland Dynamics and Responses	**Biogeochemical Controls and Effects of Mercury Contamination of the Everglades: An Ecosystem Perspective**	**Delivering Climate Change Research to Support Decision Making**	**Wetland Forest**	**Human Dimensions**
10:20am	**Tiffany Troxler**	**David Krabbenhoft**	**Young Gu Her**	**Tom Dreschel**	**Andrew Stainback**
	Introduction	**Introduction**	**Introduction**	**Introduction**	**Introduction**
10:30am	**Tiffany Troxler** Carbon Cycle Science in the Florida Coastal Everglades: Research to Inform Landscape Management	**Brett Poulin** The Influences of Dissolved Organic Matter on Mercury Bioavailability in the Florida Everglades: Insights on Organic Sulfur Chemistry	**Michael Spranger** Public Engagement Strategies to Address Today's Complex Issues	**Shimon Wdowinski** Estimating Mangrove Canopy Height and Above-Ground Biomass in the Everglades National Park with Airborne LiDAR and TanDEM-X Data	**Jennifer Cooper** Influence of Floating Aquatic Vegetation on Environmental Parameters Affecting Phosphorus Removal in the Everglades Agricultural Area
10:45am	**Ben Wilson** Biogeochemical and Physiological Effects of Simulated Sea Level Rise in the Coastal Everglades	**William Orem** Ecosystem-Wide Modeling of Methylmercury Distributions in the Everglades: Responses to Reductions in Sulfate Loading	**Young Gu Her** Modeling Strategies to Provide a Holistic Picture of Climate Change and Sea Level Rise Impacts in South Florida	**Rebecca Howard** Vegetation and Soil Elevation Dynamics in a Mangrove-Marsh Ecotone within the Picayune Strand Restoration Project Impact Area	**Timothy Collins** Risks for Florida's Native Land Snails and Residents from the New Guinea Flatworm *Platydemus manokwari*
11:00am	**Shelby Servais** Effects of Increased Salinity on Microbial Processing of Carbon and Nutrients in Brackish and Freshwater Wetland Soils	**Darren Rumbold** A Regional-Scale Ecological Risk Assessment of Mercury Across South Florida	**Yuncong Li** Impact of Climate Change and Sea Level Rise on Farmland Adjacent Everglades	**Alexandra Serna** Soil Building Processes in Re-Created Everglades Tree Islands	**Elizabeth Kelly** Fecal Indicator Bacteria (FIB) and Beach Management Policies
11:15am	**Mike Osland** Coastal Wetland Vulnerability to SLR in the Greater Everglades: A Synthesis of USGS Wetland Surface Elevation Change Studies	**Peter Frederick** Effects of Mercury Exposure on Nest Success in Great Egrets *(Ardea alba)*: The Role of Parental Care	**Mathieu Basille** Engaging Society in Every Step of the Scientific Process: A Plea for New Extension Approaches	**Mike Ross** Structure and Recent Dynamics in Coastal Everglades Tree Islands	**Kathleen Sullivan Sealey** The Dynamic Interplay Between Floods and Finance: Rebuild vs. Relocate Decisions Calculated with Restored Wetland Valuation
11:30am	**Fred Sklar** Coastal Subsidence as a Function of Salinity Intrusion and Peat Decomposition in a Karst Environment	**David Krabbenhoft** Drivers of Geospatial & Temporal Variability in the Distribution of Mercury and Methylmercury in ENP	**Pamela Fletcher** Techniques for Including Extension in Research and Reporting	**Tom Dreschel** The Ghost Tree Islands of Everglades Water Conservation Area 2A: Tracing a History of Change	**Andrew Stainback** The Economic Significance of Florida Bay
11:45am	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**
12noon-1:20pm	**Lunch Buffet Provided**				

	Thursday, April 20, 2017				
	Concurrent Sessions – 1:20pm - 3:00pm				
	Session 36	**Session 37**	**Session 38**	**Session 39**	**Session 40**
	Great Cypress	**Royal Poinciana**	**Ibis**	**Egret**	**Sandpiper**
	The DPM High-Flow Experiments: Direct Observations to Serve Adaptive Management	**Ecology and Community Dynamics of Invasive Reptiles**	**Acoustic Technology for Restoration and Management (Part 1 of 2)**	**Marl Prairie Landscape: Its Ecology and Importance in Everglades Restoration**	**Sea Level Rise and Saltwater Intrusion: Biogeochemistry and Water Quality**
1:20pm	**Jay Choi**	**John Volin**	**Erik Stabenau**	**Jay Sah**	**Todd Osborne**
	Introduction	**Introduction**	**Introduction**	**Introduction**	**Introduction**
1:30pm	**Jud Harvey** Testing the Restoration of a Free-flowing Everglades: The Decompartmentalization Physical Model (DPM) High-flow Experiments	**Brian Smith** Stable Isotopes Reveal Remarkable Niche Plasticity of Invasive Burmese Pythons	**Aaron Rice** Fish Bioacoustic Activity in Everglades National Park: Processing and Scaling for Effective Restoration and Management	**Jay Sah** Marl Prairie Landscape as the Cape Sable seaside sparrow Habitat: the Pivot of Hydrologic Restoration in Southern Everglades	**Anteneh Abiy** Evaluation of Regional Hydroclimate Variability and Links to the Hydrology and Saltwater Intrusion in South Florida
1:45pm	**Carlos Coronado** Effect of Increased Sheetflow on Sediment Transport Dynamics Along the L67C Canal	**M. Rockwell Parker** Understanding the Reproductive Chemical Ecology of Invasive Reptiles: Burmese Pythons and Argentine Tegus	**Jennifer Rehage** Understanding How Snook Respond to the Hydrological Landscape: Synchrony in Movement Over Time	**James Snyder** The Response of Muhly Grass *(Muhlenbergia capillaris* var. *filipes)*, a Prairie Dominant, to Fire and Flooding	**Steve Davis** Episodic Disturbance Effects on Florida Coastal Everglades Water Quality
2:00pm	**Mike Bush** Effects of Hydroscape Modification on Everglades Aquatic Consumers: Evaluating Two Hypotheses	**Emma Hanslowe** Assessment of Python and Boa Records from the Florida Keys	**Joseph Park** Avian Source Localization from a Small-Aperture Acoustic Array	**Thomas Virzi** Next Steps Towards Recovery of the Cape Sable Seaside Sparrow	**Miriam Jones** Impact of Sea-Level Rise on Everglades Carbon Storage Capacity
2:15pm	**Jennifer Lewis** Transport of Phosphorus with Suspended Particulates During Experimental Restoration of Everglades High Flows	**Bryan Falk** How Can We Use Activity Patterns to Improve the Management of Invasive Reptiles?	**Kevin Boswell** Predator Density and Water-Level Mediate Prey Utilization of an Intertidal Estuarine Highway	**Jesse Blanchard** Fish in Marl Prairies-Disturbance Severity, Invasions, Traits and Emergent Community Structure	**Viviana Mazzei** Functional and Compositional Responses of Periphyton Mats to Simulated Saltwater Intrusion in the Southern Everglades
2:30pm	**Christa Zweig** Scaling Active Management	**Frank Mazzotti** A Scientific Framework for a Simplified Conceptual Approach for Early Detection, Rapid Response and Removal of Invasive Wildlife: Removing Veiled Chameleons *(Chamaeleo Calyptratus)*	**Jessica Noble** How a Disturbance Event Impacted the Overwintering Home Range of Common Snook	**Jimi Sadle** Someone Has to Watch the Crabgrass Grow: A Survey of Potential Effects of Hydrologic Restoration on Marl Prairie Plant Species	**Kristie Wendelberger** Halophytes Can Salinize Soil When Competing with Glycophytes, Intensifying Effects of Sea Level Rise in Coastal Communities
2:45pm	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**	**Q&A - Discussion**
3:00pm-3:20pm	**PM Refreshment Break in Poster & Sponsor Display Area**				

Thursday, April 20, 2017

Concurrent Sessions – 3:20pm - 5:00pm

	Session 41	Session 42	Session 43	Session 44	Session 45
	Great Cypress	Royal Poinciana	Ibis	Egret	Sandpiper
	System-wide Modeling to Predict Ecological Outcomes of Restoration	**Integrating Science and Management for Controlling Invasive Species**	**Acoustic Technology for Restoration and Management (Part 2 of 2)**	**Integrated Phosphorus Management**	**Biscayne Bay**
3:20pm	**Jud Harvey**	**Vic Engel & Julien Martin**	**Jennifer Rehage**	**Melodie Naja**	**Sarah Bellmund**
	Introduction	Introduction	Introduction	Introduction	Introduction
3:30pm	**Walter Wilcox** Refining Flow Restoration to Work with the Landscape	**Brad Udell** Decision Analysis for the Optimal Control of Melaleuca	**Megan McKenna** Underwater Acoustic Monitoring in U.S. National Parks	**Yogesh Khare** Hydrologic and Water Quality Modeling for Evaluating Best Management Practices Implementation in a Western Everglades Watershed	**Sarah Bellmund** Salinity in Biscayne Bay and the Biscayne Bay Coastal Wetlands
3:45pm	**Jay Choi** Modeling Restoration Outcomes for the Everglades Ridge-Slough Landscape	**Christina Romagosa** Improving the Decision-Making Process for Early Detection and Rapid Response Actions	**Ross Boucek** Snook are Just Awesome Woodstorks Pt. 2: Assessing the Importance of Foraging Habitat at Spawning Aggregation Sites for Two Estuarine Species	**Maria Loinaz** Integrated Phosphorus Model to Evaluate Changes in Land Management in Agricultural Basins North of the Everglades	**Joan Browder** Reconstituting the Estuarine Community of Mainland Nearshore South-Central Biscayne Bay
4:00pm	**William Nardin** Multi-Vegetation Feedbacks Affecting Flow Routing and Bed Shear Stress Distributions in Everglades Ridges and Sloughs	**Daniel Slone** Risk Assessment to Inform Management Decisions: Non-Native Fishes in Everglades National Park	**Greg Hill** Fine Scale Tracking of Water Level by Sunfish: Implications for Wading Bird Foraging	**Chelsea Qiu** Hydrological Control on Phosphorus Concentration in the Everglades: The Role of Water Level Dynamics in a Marsh-Canal Hydrosystem	**Ian Zink** Nearshore Pink Shrimp Densities Relative to Habitat Limitations in Biscayne Bay: A Spatiotemporal Analysis of 10 Years of Data
4:15pm	**Laurel Larsen** Effects of Flow Reconnection on Connectivity of Biogeochemical Processes in the Everglades	**Mathieu Bonneau** Optimal Control of an Invasive Species Using a Reaction Diffusion Model and Linear Programming	**Kristen Hart** Passive Acoustic Tracking of Marine Turtles in Coral Reef Seascapes	**Hongying Zhao** A Systematic Approach in Evaluating the Source/Sink Behaviors for Water Quality Parameters in an STA Canal	**Bahram Charkian** Restoration Benefits Observed from the Biscayne Bay Coastal Wetlands Project
4:30pm	**Carl Fitz** Integrated Landscape Trends of Water Depth/ Flow, Phosphorus and Sulfate, Soil Accretion, and Vegetation Under Future Management Scenarios Including Climate Change and SLR	**Fred Johnson** Navigating the Science-Policy Boundary in Natural Resource Management	**Bradley Strickland** Using Telemetry to Elucidate the Roles of Estuarine Predators and Likely Impacts of Restoration	**Jehangir Bhadha** Phosphorus Management through Sustainable Agricultural Practices in South Florida	**Jerry Lorenz** Recent Changes in Nesting Patterns of Roseate Spoonbills in the Everglades Suggest a Response to Sea Level Rise and Global Climate Change
4:45pm	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion	Q&A - Discussion
5pm-6pm	**Networking Reception in Poster & Sponsor Display Area**				
6pm-7pm	**Closing Keynote Address** **Michael Grunwald**, senior writer for Politico Magazine, and Editor-at-Large of POLITICO's new public policy site, The Agenda.				
7pm-8pm	**Stay afterward for a BOOK SIGNING and chance to meet the author.** Both of the following books will be available at $20 each (cash only please). *The Swamp: The Everglades, Florida, and the Politics of Paradise* -and- *The New New Deal: The Hidden Story of Change in the Obama Era*				
7pm-9pm	**Exhibitor and Poster Move-out — Conference Concludes**				

Poster Display Information

Poster presentations play a key role in the exchange of information at GEER 2017. Considerable time is dedicated viewing them, giving scientists, policy makers, planners, practitioners and managers valuable opportunities to interact and share details of their work, successes and lessons learned.

Poster Session One:

Poster Set Up:	**Monday, April 17, 3:00pm – 6:00pm** *(You may also set up during breakfast the next morning.)*
Formal Poster Session:	Tuesday, April 18, 5:00pm – 7:15pm
5:30pm – 6:15pm	Presenters at **Odd Numbered Boards*** are asked to stand at their posters.
6:15pm – 6:30pm	Prize Drawing *(Must be present to win.)*
6:30pm – 7:15pm	Presenters at **Even Numbered Boards*** are asked to stand at their posters.
Poster Removal:	**Wednesday, April 19, 10:00am – 10:20am** *(During the mid-morning refreshment break.)*

Poster Session Two:

Poster Set Up:	**Wednesday, April 19, 12:00pm – 1:00pm** *(During the lunch break.)*
Formal Poster Session:	Thursday, April 20, 8:30am – 10:15am
8:30am – 9:15am	Presenters at **Odd Numbered Boards*** are asked to stand at their posters.
9:15am – 9:30am	Prize Drawing *(Must be present to win.)*
9:30am – 10:15am	Presenters at **Even Numbered Boards*** are asked to stand at their posters.
Poster Removal:	**Thursday, April 20, 7:00pm** *(Immediately following the closing keynote presentation.)*

*As a courtesy to the presenter before/after you, please only stand at your poster during the assigned session. Posters are divided into two sessions. Consult the poster directory to confirm your session assignment.

Poster display boards will be dismantled by the vendor Thursday evening after the closing address. Organizers are not responsible for lost posters discarded by the board vendor. Thank you.

Poster Directory

(Presenters listed in alphabetical order by last name)

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
56	Mr.	Omar	Abdelrahman	Miami-Dade County Division of Environmental Resources Management	Miami	FL	Surface Water Quality Monitoring Program within Biscayne Bay Aquatic Preserves and Biscayne National Park: Tracking Trends to Predict Impacts	**Session Two**
33	Mr.	Gordon	Anderson	U.S. Geological Survey	Gainesville	FL	First Year Observations of Groundwater and Surface Water Salinity Variability in the Eastern Panhandle Marsh: Developing a Restoration Groundwater Salinity Baseline, Everglades National Park, FL, USA	**Session One**
77	Mr.	Joseph	Andreoli	University of Florida, Department of Geography	Gainesville	FL	Predicting the Potential Geographic Distributions of Non-Native Fishes in Florida with Climate Change	**Session Two**
73	Mr.	Christian	Avila	Miami-Dade County	Miami	FL	An Update on Recent Salinity and Submerged Aquatic Vegetation Trends in Northeastern Florida Bay	**Session Two**
63	Ms.	Sara	Baker	University of Florida/ IFAS, Soil and Water Sciences Department	Gainesville	FL	Effects of Flow on Enzyme Activity in the Everglades Stormwater Treatment Areas	**Session Two**
2	Mr.	John	Baldwin	South Plantation High School	Planation	FL	Bringing the Classroom to the Science: High School Internship in Everglades Ecosystem Ecology	**Session One**
57	Dr.	Timothy	Bargar	U.S. Geological Survey	Gainesville	FL	Baseline Aquatic Contamination and Endocrine Status in a Resident Fish of Biscayne National Park	**Session Two**
10	Dr.	James	Beerens	U.S. Geological Survey	Davie	FL	Cape Sable Seaside Sparrow Decision Support Tools for Water Management	**Session One**
86	Dr.	James	Beerens	U.S. Geological Survey	Davie	FL	Habitat Selection of the Burmese Python in the Florida Everglades	**Session Two**
93	Mrs.	Allison	Benscoter	U.S. Geological Survey	Fort Lauderdale	FL	Assessing the Role of Fire Disturbance in Maintaining Cape Sable Seaside Sparrow *(Ammodramus maritimus mirabilis)* Habitat Use	**Session Two**
28	Ms.	Jeanne	Bermudez	Florida Atlantic University (FAU)	Southwest Ranches	FL	Effects of Freshwater Acidification on Microalgal Growth Rates and Pigment-Based Chemotaxonomy	**Session One**
41	Dr.	Henry	Briceño	Florida International University (FIU)	Miami	FL	Potential Trajectories of Water Quality Forced by Sea Level Rise in the Florida Coastal Everglades	**Session One**
42	Dr.	Henry	Briceño	Florida International University (FIU)	Miami	FL	Total Phosphorous Levels in Surface Water Discharges to Shark River Slough, Everglades National Park	**Session One**

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
13	Dr.	Venetia	Briggs-Gonzalez	University of Florida/ IFAS, Wildlife Ecology & Conservation	Davie	FL	Survival and Population Growth of the American Crocodile *(Crocodylus acutus)*	**Session One**
94	Mr.	David	Bucklin	University of Florida/ IFAS, Fort Lauderdale Research & Education Center	Davie	FL	Spatio-Temporal Niche Differentiation for Sea Turtles Tracked In and Around Dry Tortugas National Park, FL	**Session Two**
75	Mr.	David W.	Ceilley	Johnson Engineering Inc.	Fort Myers	DC	Restoration of a Valued Ecosystem Component, *Vallisneria americana* in the Caloosahatchee River & Estuary	**Session Two**
17	Dr.	Jennifer	Chastant	Palm Beach County	West Palm Beach	FL	Landscape-Level Correlates of Wading Bird Stress in a Seasonally Fluctuating, Subtropical Lake	**Session One**
95	Mr.	Michael	Cherkiss	U.S. Geological Survey	Davie	FL	Sea Turtle Nesting in Everglades National Park: Integrating Beach Surveys, Satellite Tracking, and Genetics	**Session Two**
60	Dr.	Michael	Chimney	South Florida Water Management District	West Palm Beach	FL	Period-of-Record Phosphorus Retention in the Everglades Stormwater Treatment Areas – 1994 to 2016	**Session Two**
24	Dr.	Xavier	Comas	Florida Atlantic University (FAU)	Boca Raton	FL	Exploring the Potential of Ground Penetrating Radar (GPR) for Delineating the Extent of Burned Peat Soils in Palangkaraya, Indonesia	**Session One**
14	Mr.	Jeremy	Conrad	U.S. Fish and Wildlife Service	Sanibel	FL	Identifying the Effects of Eutrophication on Drivers of Elevation Change in Florida's Mangroves	**Session One**
31	Mr.	Paul	Conrads	U.S. Geological Survey	Columbia	SC	Application of the Coastal Salinity Index to Sites in Florida Bay and the Gulf of Mexico	**Session One**
30	Mr.	Paul	Conrads	U.S. Geological Survey	Columbia	SC	Use of Everglades Depth Estimation Network (EDEN) to Develop Water-Level Gradients and Fluxes	**Session One**
32	Mr.	Paul	Conrads	U.S. Geological Survey	Columbia	SC	Using the Everglades Depth Estimation Network (EDEN) to Characterize Coastal Salinity Conditions	**Session One**
23	Ms.	Jessica	Dell	Florida Atlantic University (FAU)	Davie	FL	The Effects of Willow Encroachment on the Resilience of Peat Carbon Storage in an Herbaceous Wetland	**Session One**
35	Dr.	Tibebe	Dessalegne	South Florida Water Management District	West Palm Beach	FL	Future Rainfall Depth-Duration-Frequency Curve Estimates Under Various Climate Change Scenarios	**Session One**
43	Mr.	Bobby	Duersch	Florida Atlantic University (FAU)	Boca Raton	FL	Phosphorous Speciation Using P31 Nuclear Magnetic Resonance Spectroscopy in Order to Trace Phosphorous Sources and Movement in the C51 Basin and Northern Everglades	**Session One**
67	Mr.	Cody	Eggenberger	Florida International University (FIU)	Miami	FL	Habitat Use of Key Recreational Fish Species in Altered Coastal Everglades Lakes	**Session Two**

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
51	Dr.	Edwin	Everham	Florida Gulf Coast University	Fort Myers	FL	Measuring the Fate and Non-Target Impacts of Dibrom Using Aerial Ultra-Low Volume (ULV) Spray Technology in Mangrove and Open Marsh Wetlands in South Florida	**Session Two**
52	Dr.	Edwin	Everham	Florida Gulf Coast University	Fort Myers	FL	State of Lake Trafford Following Restoration Dredging	**Session Two**
90	Mr.	Thomas	Faughnan	Florida Atlantic University (FAU)	Boca Raton	FL	Effects of Juvenile Alligators on Dry-Season Aquatic Fauna Concentration	**Session Two**
25	Dr.	Hilary	Flower	University of South Florida	Tampa	FL	Can The Everglades Survive Climate Change? Envisioning the Everglades Under Climate Change and Sea Level Rise	**Session One**
74	Mr.	Zachary	Fratto	National Park Service	Key Largo	FL	Florida Bay Algal Bloom Dynamics	**Session Two**
53	Ms.	Ariel	Freidenreich	Florida International University (FIU)	Miami	FL	Effects of Prescribed Burn on Pine Rockland Soil Health and Plant Communities within FIU's Nature Preserve	**Session Two**
68	Ms.	Carissa	Gervasi	Florida International University (FIU)	Miami	FL	Detecting and Countering Fisheries-Induced Evolution Using Marine Protected Areas	**Session Two**
83	Mr.	Daniel	Hagood	Florida Atlantic University (FAU)	Davie	FL	Influence of Soil Disturbance and Fire on the Distribution of Caesar's Weed *(Urena lobata)* in Pine Flatwoods	**Session Two**
11	Ms.	Saira	Haider	U.S. Geological Survey	Davie	FL	Validation of Near-Term Everglades Water Depth Forecasts	**Session One**
78	Dr.	J. Matthew	Hoch	Nova Southeastern University	Fort Lauderdale	FL	Behavioral Response of Small Everglades Fish to Hydrological Variation, Predator Cues and Parasites	**Session Two**
92	Dr.	Margaret	Hunter	U.S. Geological Survey	Gainesville	FL	Population Genetic Analysis of the Endangered Cape Sable Seaside Sparrow in Everglades National Park	**Session Two**
47	Mr.	Erik	Iverson	MacArthur Agro-ecology Research Center	Lake Placid	FL	The Influence of Native Tree Expansion on Ecosystem Services in the Headwaters of the Everglades	**Session One**
19	Ms.	Anupama	John	Florida International University (FIU)	Miami	FL	Laboratory Assessment of Hydraulic Properties of Heterogeneous Organic Soils in the Everglades	**Session One**
64	Mr.	Paul	Julian	University of Florida	Lehigh Acres	FL	Key Factors Controlling Wetland Aquatic Productivity in the Everglades Stormwater Treatment Areas	**Session Two**
85	Mr.	Frank	Kahoun	Quest Ecology/ Antioch University New Hampshire	Tamarac	FL	Structural Microhabitat Utilization of the Invasive Cuban Brown Anole *(Anolis sagrei)* in a Naturalized Habitat of South Florida	**Session Two**

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
39	Mr.	Michael	Kiflai	Florida International University (FIU)	Miami	FL	Hydrogeophysical Characterization of Groundwater in the Mangrove Lakes Region of Everglades National Park	Session One
44	Mrs.	Kalindhi	Larios	University of Florida/ IFAS, Soil and Water Sciences Department	Gainesville	FL	Sensitivity Analysis of Total Phosphorus in a Wetland Biogeochemical Model	Session One
48	Dr.	J William	Louda	Florida Atlantic University (FAU)	Boca Raton	FL	Conceptual SolarMarsh: Combined Stormwater Treatment Area and Electrical Generation	Session One
82	Mr.	Ian	Markovich	University of Florida/ IFAS, Fort Lauderdale Research & Education Center	Davie	FL	Do Daylength and Desiccation Affect Sprouting of Crested Floatingheart Ramets?	Session Two
45	Dr.	Frank	Marshall	Cetacean Logic Foundation	New Smyrna Beach	FL	Interpreting Freshwater Paleoecological Studies to Better Understand the Impact of 20th Century Alterations on the Hydrology and Salinity in Everglades National Park	Session One
20	Mr.	Matthew	McClellan	Florida Atlantic University (FAU)	Boca Raton	FL	Spatial Variability in Production and Releases of Biogenic Gases from Two Subtropical Wetland Ecosystems in Central Florida is Revealed Using Hydrogeophysical Methods	Session One
71	Ms.	Amanda	McDonald	South Florida Water Management District	West Palm Beach	FL	Drought Conditions Set Up the 2015 Collapse of Florida Bay Seagrass	Session Two
18	Dr.	Christopher	McVoy	Long Slough Research	Lake Worth	FL	A Research Platform in the Florida Everglades for Investigating the Interactions Among Hydrology, Water Management and Organic Carbon Cycling	Session One
79	Ms.	Gaia	Meigs-Friend	U.S. Geological Survey	Gainesville	FL	Environmental DNA (eDNA) Detection of Burmese Pythons in the Arm Loxahatchee National Wildlife Refuge and Southeast Florida Using State-of-the-Art Droplet Digital PCR	Session Two
89	Mr.	Steve	Mortellaro	U.S. Fish and Wildlife Service	Vero Beach	FL	Effectiveness of Surveying for Eastern Indigo Snakes Using Artificial Covers	Session Two
91	Ms.	Jennifer	Nestler	U.S. Fish and Wildlife Service	Davie	FL	Variation in Body Condition of *Alligator mississippiensis* in Florida	Session Two
27	Dr.	Danielle	Ogurcak	Florida International University (FIU)	Miami	FL	Stabilization of Everglades' Cultural Resource Sites with Integrated Ecosystem Restoration	Session One
65	Dr.	Todd	Osborne	University of Florida	St. Augustine	FL	Spatial Distributions of Soil Biogeochemical Properties in Stormwater Treatment Area 3/4 Cell 3A and 3B	Session Two
38	Dr.	Gina	Paduano Ralph	U.S. Army Corps of Engineers	Jacksonville	FL	Modified Water Deliveries to Everglades National Park: An Incremental Approach to Restoration	Session One

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
40	Mr.	Matthew	Petkewich	U.S. Geological Survey	Columbia	SC	Improving Dry-Season Water Surfaces by Using Below Ground Estimates for the Everglades Depth Estimation Network (EDEN)	**Session One**
61	Mr.	Matt	Powers	South Florida Water Management District	West Palm Beach	FL	Evaluation of Potential for Rooted Floating Aquatic Vegetation to Further Reduce Low-Level Phosphorus Concentrations in the Everglades Stormwater Treatment Areas	**Session Two**
5	Ms.	Michelle	Prats	National Park Service	Palmetto Bay	FL	The Everglades National Park and Big Cypress National Preserve Vegetation Mapping Project: Region 2 – Taylor Slough	**Session One**
76	Ms.	Kristen	Reaver	Cherokee Nations	Gainesville	FL	Trojan Y for Control of Non-Native Fishes: Moving from Theory to Practical Application	**Session Two**
55	Mr.	Dillon	Reio	Florida International University (FIU)	Miami	FL	Investigating the Effects of Land-Use Change on the Hydrologic Conditions of a Restored Agricultural Area in Everglades National Park	**Session Two**
3	Mrs.	Vanessa	Reyes	Florida International University (FIU)	Miami	FL	Seven Decades of Mangrove Expansion Along Coastal Everglades: A Remote Sensing Approach	**Session One**
66	Ms.	Kaylee	Rice	University of Florida/ IFAS, Soil and Water Sciences Department	Gainesville	FL	Vegetation Effects on Microbial Enzyme Activities in Soils of the Stormwater Treatment Areas	**Session Two**
15	Mr.	Andres	Rodriguez	University of Florida	Belle Glade	FL	Influence of Carbon Lability and Flooding Treatment in Potential Oxidation of Histosols in the Everglades Agricultural Area	**Session One**
96	Ms.	Mica	Rumbach	Audubon Florida	Naples	FL	Ecological Monitoring to Track Succession and Evaluate Performance of a Western Everglades Mitigation Bank	**Session Two**
58	Dr.	Darren	Rumbold	Florida Gulf Coast University	Fort Myers	FL	A Formal Causal Analysis of Drivers Responsible for Geographic and Temporal Variability in Mercury Biomagnification Across the Everglades	**Session Two**
80	Dr.	Pamela	Schofield	U.S. Geological Survey	Gainesville	FL	Development of Environmental DNA Probe for Early Detection of Bullseye Snakehead *Channa marulius*	**Session Two**
88	Mr.	Nicholas	Scobel	University of Florida/ IFAS, Fort Lauderdale Research & Education Center	Davie	FL	Update on Trapping Nile Monitors *(Varanus niloticus)* in Southeast Florida	**Session Two**
54	Ms.	Anne	Sexton	University of Florida	Belle Glade	FL	Floating Aquatic Vegetation Suppression Effects on Canal Sediment Properties in South Florida	**Session Two**
37	Mr.	Michael	Simmons	U.S. Army Corps of Engineers	Jacksonville	FL	Restoring Pre-Development Hydrology in Biscayne Bay: The Recover Planning Process	**Session One**

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
22	Mr.	Matthew	Sirianni	Florida Atlantic University (FAU)	Boca Raton	FL	The Effect of Increased Fluid Conductivity in Peat Soils from the Everglades: Implications for Biogenic Gas Production and Release Under a Sea Level Rise Scenario	**Session One**
87	Mr.	Brian	Smith	University of Florida/ IFAS, Fort Lauderdale Research & Education Center	Davie	FL	Using GPS Biologging Technology to Track Movements of Invasive Burmese Pythons	**Session Two**
59	Mr.	Taylor	Smith	University of Florida/ IFAS, Soil and Water Sciences Department	Gainesville	FL	Influence of Vegetation on Soil Phosphorus Forms in the Everglades Stormwater Treatment Areas (STA): STA-2 as a Case Example	**Session Two**
36	Dr.	Lawrence	Spencer	South Florida Water Management District	West Palm Beach	FL	Hydroperiod Analysis Toolsets: Innovative Tools to Build New Analyses	**Session One**
70	Ms.	Bethany	Stackhouse	U.S. Geological Survey	Reston	VA	Molluscan Response Due to 2015 Seagrass Die-Off in Western Florida Bay	**Session Two**
69	Dr.	David	Stormer	Florida International University (FIU)	Miami	FL	Effects of the Long-Term Marine Closure and Reopening of an Area of the Coastal Florida Everglades on Fishes and Recreational Fisheries	**Session Two**
72	Dr.	Theresa	Strazisar	Florida Atlantic University (FAU)	Boca Raton	FL	A Numerical Simulation Model of *Ruppia maritima* (Wigeongrass) at the Everglades-Florida Bay Ecotone: Model Development and Assessment of Population Persistence	**Session Two**
12	Dr.	David	Sumner	U.S. Geological Survey Caribbean-Florida Water Science Center	Lutz	FL	Spatiotemporal Distribution of Solar Insolation in Florida	**Session One**
7	Mr.	Kyle	Thayer	University of Florida/ IFAS, Fort Lauderdale Research & Education Center	Davie	FL	Getting in Touch with Your Inner McGuyver: Lessons Learned from Field Research in Aquatic Ecosystems	**Session One**
81	Ms.	Amelia	Ulmer	U.S. Geological Survey Wetland and Aquatic Research Center	Gainesville	FL	Testing Inhibitor Removal from Environmental DNA (eDNA) Samples for the Detection of Rare or Cryptic Species in the Greater Everglades Ecosystem	**Session Two**
34	Ms.	Kalli	Unthank	Florida International University (FIU)	Miami	FL	Influence of C-111 Spreader Canal on Groundwater Levels in the C-111 Basin and Taylor Slough Area, Miami-Dade County, Florida	**Session One**
26	Dr.	Craig	van der Heiden	Institute for Regional Conservation	Delray Beach	FL	Plant Community Changes Intermediate on the Halocline Between Mangrove and Upland Habitat of the National Key Deer Refuge 1990-2013	**Session One**

Poster No.	Prefix	First Name	Last Name	Organization	City	ST	Abstract Title	Session No.
29	Mr.	Joel	VanArman	Self-employed	Lake Worth	FL	Fifteen Year Follow-up Survey to Assess the Progress of a Cypress-Pond Apple Tree Planting Project in the Loxahatchee National Wildlife Refuge, Boynton Beach, FL, USA	Session One
62	Dr.	Lilit	Vardanyan	University of Florida/ IFAS, Soil and Water Sciences Department	Gainesville	FL	Organic Phosphorus Forms in the Everglades Wetland Soils	Session Two
97	Dr.	Anna	Vecchione	Sea Life Conservation and Arts	Charleston	SC	Evaluation of Mercury and Toxic Metals Concentrations in Tissues of Ospreys Admitted at South Florida Wildlife Center	Session Two
46	Mrs.	Zoe	Verlaak	Florida International University (FIU)	Miami	FL	Influence of the Benthic Foraminiferal Biocoenosis on Fossil Assemblages in the Southwestern Everglades	Session One
6	Dr.	John	Volin	University of Connecticut	Storrs	CT	Digital Visualization as a Tool to Bridge Science and Policy: Examining the Long-Term Effects of Phosphorus on the Everglades Ridge Slough Landscape	Session One
8	Mr.	Paul	Walansky	Stanley Consulting	West Palm Beach	FL	Using FLUCCS Codes and GIS Spatial Analyst Tools for Wetland Restoration	Session One
4	Dr.	Shimon	Wdowinski	Florida International University (FIU)	Miami	FL	Space-Based Monitoring of Water Level Changes in the Entire Everglades Using Sentinel-1 InSAR Observations	Session One
9	Mr.	William	Wright	Florida Atlantic University (FAU)	Boca Raton	FL	Time-Lapse Geophysical Measurements Targeting Spatial and Temporal Variability in Biogenic Gas Production from Everglades Peat Soils at the Loxahatchee Impoundment Landscape Assessment (LILA)	Session One
16	Mr.	Lu	Zhai	University of Miami	Coral Gables	FL	Quantifying Spatial Range of Sea Level Rise Impact on Vegetation Community: A Field and Model Combination Study Based on Carbon Stable Isotope	Session One
84	Prof.	Caiyun	Zhang	Florida Atlantic University (FAU)	Boca Raton	FL	Applying Time Series Landsat Data for Vegetation Change Analysis in the Florida Everglades Water Conservation Area 2A during 1996-2016	Session Two
21	Dr.	Xiaoyan	Zhu	University of Florida Tropical Research and Education Center	Homestead	FL	Greenhouse Gas Emissions from the Herbaceous Peatland	Session One

PDHs for Engineers and Continuing Education

CEUs

CEUs & PDHs For Attendees with Professional Certifications

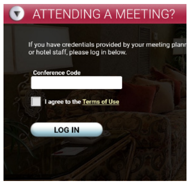
If you are a licensed engineer or maintain a professional license issued by a society, an association, an occupational licensing board or a department of professional regulation within your state, you may be eligible to earn Continuing Education Units (CEUs) for your participation in this conference. You will need to contact the appropriate authority who manages your professional certification to verify your organization or individual state's licensing requirements, and to confirm what documentation is required. While we are not approved as an official CEU provider, your state may recognize this event as a qualified program, and you may be eligible to earn CEUs for your participation.

Record of Attendance Log at Registration Desk

A Record of Attendance Log will be maintained at the Conference Registration Desk where you can sign in and sign out each day and create a record verifying your daily attendance. Within 30 days upon conclusion of the conference, we will email you a "Certificate of Attendance" indicating the actual number of contact hours you accrued based on your participation hours recorded in the attendance log. It is your responsibility to compile all necessary paperwork and provide it to the appropriate licensing board or professional organization with whom you are certified, and to confirm this program content is acceptable based on their individual standards.

IMPORTANT NOTE: In general, one Continuing Education Unit (CEU) is defined as 10 hours of instruction. One hour is calculated as 50 minutes of face-to-face instruction. If you have any questions regarding CEU requirements as they pertain to your professional certification or license, please directly contact the appropriate licensing board within your state. The University of Florida, Office of Conferences & Institutes and its employees are not authorized to act on your behalf or to provide consult regarding CEUs.

Additional Information



Free Internet Access

Complimentary wireless internet access will be available to GEER attendees in the meeting space, hotel lobby, and public & lounge areas. The passcode is different for access in your guest room. Be sure to obtain the most current complimentary access code from the front desk when you check in. To access internet in the conference center, follow these instructions on your device:

1. Connect to the network "Marriott_CONF"
2. You will be directed to the splash page (Attending Meeting) where you will enter:
   Conference Code: **GEER2017**
3. Click on I agree on the term
4. Click on log in

Meeting Space for Impromptu Meetings

The Flamingo Room has been reserved for those who wish to organize impromptu meetings with colleagues while you are gathered here at GEER. Availability is on a first-come, first-served basis. There is a sign-up sheet on the conference message board in the Grand Floridian Foyer in the Conference Center near the registration desk. Please note the room is set for a maximum of 22 people (U-Shape), and no Audio Visual (AV) equipment is provided. Flamingo is located just past the front desk. Be sure to indicate the group contact name and cell number when you reserve space so we can reach you if we need to.

Name Badge

Your name badge will serve as your pass while attending GEER 2017, so please be sure to wear it while attending all conference functions. If arriving Monday, you should pick up your name badge and materials that evening to avoid the Tuesday morning rush. Conference Registration is open 4:00pm-7:00pm Monday, April 17 in the Conference Center building. It reopens Tuesday morning at 7:30am. Please be sure to register all guests and pay the applicable registration fees. Guests must also wear their name badges for entry into functions. The guest fee allows guests 16 years of age and older to attend the Welcome Social on Monday evening, the Poster Session Networking Reception on Tuesday evening, and the Networking Reception Thursday evening. The guest fee does not include meeting attendance.

Lost & Found

When an article is lost, please first check the conference registration area. If the lost article(s) cannot be found, check with the hotel's front desk staff.

Remember to Join Us on Social Media!

Follow us on Twitter @GEER_Conference and like us on Facebook @GEERConference to see our posts.
Use the hashtag #geerconference to stay connected with your fellow conference attendees.

Conference Abstracts

Listed alphabetically by presenting author last name.
Presenting author names appear in **bold.**

SURFACE WATER QUALITY MONITORING PROGRAM WITHIN BISCAYNE BAY AQUATIC PRESERVES AND BISCAYNE NATIONAL PARK: TRACKING TRENDS TO PREDICT IMPACTS

Omar Abdelrahman, *Maurice Pierre, Kathryne Wilson, Christian Avila, Jamie Monty*
Miami-Dade County Department of Regulatory and Economic Resources, Division of Environmental Resources Management (DERM), FL, USA

The boundaries of Biscayne Bay Aquatic Preserves and Biscayne National Park both fall within Biscayne Bay, which has been designated an 'Outstanding Florida Water'. This waterbody is located next to some of the most intensely developed and densely populated regions of South Florida, consequentially exposing it to numerous challenges, including aging sewer infrastructure, extensive septic systems, agriculture and domestic runoff, and other urban-related runoff, all of which affect the watershed. As indicated by the marine protected area designations within it, Biscayne Bay supports a vibrant, diverse, and abundant flora and fauna. Therefore, the multiple and continuous aforementioned pressures on the water quality of the Bay make understanding the status and trends in surface water quality paramount. With the recent climate-related fluctuations in seasonal weather, and the recent multiple occurrences of algal blooms, it is essential that we continue to not only monitor the Bay, but to be able to predict impacts, so that management agencies can make better informed, and more proactive, decisions.

We selected a set of parameters that are likely to have biological responses for evaluation using the Z-CUMSUM approach employed by Briceno, et al. and other chemical parameters that would help us better predict surface water quality imbalances, which may lead to conditions inconsistent with sound ecological balance for a subtropical oligotrophic estuary. In order to compartmentalize the different areas of the Bay, we will be using the geographical delineations designated for the state of Florida's Numeric Nutrient Criteria assessments (62-302.532 F.A.C.), and assigning those sections to the North, Central, and South regions of the Bay.

Preliminary evaluations with methods suggest an increasing trend for several parameters including: Total Nitrogen, Chlorophyll-A, and Total Phosphorus. Conversely, salinity and pH values appear to be decreasing throughout the Bay.

<u>BIO</u>: Omar Abdelrahman completed his graduate degree at FIU with a thesis on urban avifauna. He has been at Miami-Dade DERM for 14years focusing on the sampling program's quality assurance, and conducting assessments of water quality issues throughout the urban watershed.

<u>Contact Information</u>: Omar Abdelrahman, Miami–Dade County DERM, 701 NW 1st Ct, Ste. 500, Miami, FL 33136, Phone: 305-372-6872, Email: abdelo@miamidade.gov

EVALUATION OF REGIONAL HYDROCLIMATE VARIABILITY AND LINKS TO THE HYDROLOGY AND SALTWATER INTRUSION IN SOUTH FLORIDA

Anteneh Abiy[1], *Wossenu Abitew*[2], *Assefa Melesse*[1]
[1]Department of Earth and Environmental, Florida International University, Miami, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL , USA

Driven by natural variabilities of sea surface temperature, El Niño–Southern Oscillation (ENSO) fluctuations, among others; play an important role on the distribution of rainfall at local and regional scale. The rainfall distribution in south Florida is known to have a strong correlation with ENSO variabilities, where El Niño years present a wet season, rainfall higher than average; and rainfall decreases significantly during La Niña phase of the oscillation. Although, the La Nina phase has a strong influence in declining the local rainfall leading to sever drought; its impact on groundwater is not clear. It is evident that declining rainfall a decline the groundwater head which further can trigger an accelerated saltwater intrusion in the area. The objective of this study is to evaluate the relation of groundwater head fluctuation and related saltwater intrusion with the different phased and magnitude of ENSO. Application of Fourier transformation, power spectral analysis and multiple regression techniques. The study presents how each of these variables fluctuate with time, the frequency and power spectral component of these parameters are compared. A multiple regression of the combined parameters has presented how the local hydrology and saltwater intrusion is driven by natural hydroclimate variabilities.

BIO: Anteneh Abiy is a PhD student at the Department of Earth and Environment, Florida International University. With Applied Geology (BSc) and Integrated Watershed Management and Hydrology (Ms) background, Anteneh has field and modeling experience and has authored and coauthor peer review papers and technical reports in the field.

Contact Information: Anteneh Abiy, Florida International University, 11200 SW 8th Street, Miami, FL 33199, Phone: 786-482-0118, Email: aabiy001@fiu.edu

HYDROCHEMICAL CONDITIONS OF TWO ESTUARINE MANGROVE LAKE DRAINAGE SYSTEMS IN THE EVERGLADES

*René M. Price[1], **Joshua M. Allen[1]**, Dean Whitman[1], Thomas A. Frankovich[1], James W. Fourqurean[1], Mark Zucker[2]*
[1]Florida International University, Miami, FL, USA
[2]U.S. Geological Survey, Davie, FL, USA

The Florida Everglades have been subject to major alterations in hydrology over the last century, resulting in a shift in the relative importance of different nutrient pathways to coastal estuaries. Brackish coastal groundwater discharge (CGD), an inland intrusion of submarine groundwater discharge caused by sea level rise and reduced freshwater input, has been shown to be enriched in total phosphorus, the limiting nutrient in the coastal Everglades. One aim of the Comprehensive Everglades Restoration Plan is to increase freshwater flow in the coastal Everglades and adjacent bays in order to restore a salinity and a nutrient regime conducive for the development of submerged aquatic vegetation. This study is being conducted in the southern central portion of the Florida Everglades in a group of estuarine mangrove lakes that connect to Florida Bay west of Taylor Slough. The lakes comprise two distinct drainage systems; the Alligator Creek System (ACS) and the McCormick Creek System (MCS). Water quality has diminished in the lakes over the last century, possibly due to CGD. A possible hydraulic connection between southern Taylor Slough and the mangrove lakes region to the west may provide the fresh water necessary to improve lake water quality.

Hydrologic and chemical conditions are being monitored throughout the lakes in order to gain a better understanding of restoration efforts through time. Comparison of groundwater and surface water levels reveals a potential for groundwater discharge to the lakes during most of the year. Salinity in the surface water of the lakes varies seasonally, while groundwater salinity is fairly constant. Lower salinity conditions are observed in groundwater in the eastern drainage system (MCS) than in the western drainage system (ACS). In addition, total phosphorus concentrations in MCS surface waters are generally below 1 µM, while reaching as high as 6 µM in ACS. These findings suggest the possibility of a higher incidence of CGD in ACS than in MCS. Results from this study can be used to assess how restoration efforts may influence the hydrochemical conditions of mangrove lakes affected by sea level rise and CGD.

BIO: Joshua Allen is a third year Ph.D. student in the Department of Earth and Environment at FIU. He is currently studying groundwater/surface water interactions in the Everglades.

Contact Information: Joshua Allen, Florida International University, 11200 SW 8th St., Miami, FL 33199, USA, Phone: 305-348-0281, Email: jalle091@fiu.edu

FIRST YEAR OBSERVATIONS OF GROUNDWATER AND SURFACE WATER SALINITY VARIABILITY IN THE EASTERN PANHANDLE MARSH: DEVELOPING A RESTORATION GROUNDWATER SALINITY BASELINE, EVERGLADES NATIONAL PARK, FL, USA

***Gordon Anderson*[1]**, *Amy Renshaw*[2] *and Michael Kline*[3]

[1]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

[2]Everglades National Park, South Florida Natural Resources Center, Homestead, FL USA

[3]Florida Audubon, Audubon Everglades Science Center, Tavernier, FL, USA

The Eastern Panhandle (EP) marsh within Everglades National Park (ENP) is located below the C-111 canal and hydrologically disconnected from its historical freshwater watershed to the north. EP land is comprised of carbonate marl sediment with sparse freshwater vegetation near the C-111 canal transitioning into a patchwork of scrub Red Mangrove and ephemeral creeks which drain east into Long Sound (LS) and west into Joe Bay (JB).

Rainfall interception within the EP marsh is the primary source of upland freshwater sheetflow into NE Florida Bay when canal overbank flow is limited.

In October 2015, two inactive U.S. Geological Survey paired shallow groundwater (GW) and surface water (SW) monitoring wells (LJB and LHC) in the lower EP marsh of ENP were re-gaged to establish a GW/SW salinity baseline in the EP, and in anticipation of water delivery modifications from the pending Eastern C-111 Spreader Canal and Biscayne Bay Coastal Wetlands (C111SCEP/BBCW) projects to begin in 2020.

The Western C-111 Spreader Canal Project Phase I (C111SCWP) was completed in 2012, enhancing upland canal water deliveries into the Taylor Slough, west of the EP lands. However, the project may have further reduced C111 canal discharge availability into the EP and exacerbated the freshwater supply to NE Florida Bay. The pending C111SCEP/BBCW projects are directed to improve upland water storage and flow into the EP and Florida Bay.

Salinity data during the first year of monitoring was indicative of two extreme weather cycles: the worst drought in over 25 years occurred (Spring 2014-Summer 2015) creating a damaging hypersaline condition to the marsh, followed by the second wettest winter (Nov 2015-Feb 2016) on record (1896-2016) caused by an ENSO (El Nino). At both gages, highest GW and SW salinities were observed in October 2015 (GW ~29 and SW ~20 PSU) and lowest salinities for GW were observed in March 2016 (~ 27 PSU). SW salinities had two seasonal lows, September 2016 (0.8 PSU) and February 2016 (1.3 PSU) as a result of excessive winter rainfall. GW salinity readings didn't fluctuate more than ~ 2 PSU during the year; whereas, SW salinity ranged from 0.8 to 21.6 PSU.

Our USGS science partners, ENP and Florida Audubon (NAS), have monitored surface water hydrology in the EP and in NE Florida Bay since the late 1980's. However, gages LHC and LJB are the only active shallow groundwater wells in the EP, and can provide valuable insight into the salinity residence time in the ground and sediment substrate. These are useful metrics in aiding land managers to monitor conditions in the coastal wetlands, and maintain habitat that are vital of Florida Bay.

BIO: Mr. Anderson has been involved in Everglades wetlands science since 1989. In addition to this coastal groundwater study presented at GEER 2017, he is currently working on coastal mangrove-marsh sediment dynamics in the Everglades and in the Indian River Lagoon, Florida.

Contact Information: Gordon Anderson, U.S. Geological Survey, 7920 NW 71st Street, Gainesville, FL, USA 32653, Phone: 352-264-3487, Email: gordon_anderson@usgs.gov

PREDICTING THE POTENTIAL GEOGRAPHIC DISTRIBUTIONS OF NON-NATIVE FISHES IN FLORIDA WITH CLIMATE CHANGE

***Joseph A. Andreoli*[1]**, *Jesse R. Blanchard*[2], *Jennifer S. Rehage*[2], *Jeffrey E. Hill*[3]
[1]University of Florida, Gainesville, FL, USA
[2]Florida International University, Miami, FL, USA
[3]University of Florida, Ruskin, FL, USA

Non-native species and climate change are two of the most pressing issues facing Florida in the Anthropocene. Due to Florida's extensive hydrological alteration, subtropical climate, and large population size, the state is a hotspot for non-native fish establishment. These species may cause various environmental and socioeconomic impacts to the state. This study is focused on the potential geographic distributions of a dozen species, several of which are invasive in the Everglades ecosystem: African Jewelfish, Asian Swamp Eel, Black Acara, Blackchin Tilapia, Blue Tilapia, Brown Hoplo, Butterfly Peacock Bass, Mayan Cichlid, Oscar, Pike Killifish, Spotted Tilapia, Walking Catfish. African Jewelfish in particular are a chief concern of Everglades ichthyologists as they are now the second most abundant fish in some portions of the Everglades, and have been rapidly expanding. Similarly, the Asian Swamp Eel was recently noted as expanding across Everglades National Park (ENP), and Mayan Cichlids are recovering from the 2010 cold snap in ENP. All of the other species we looked at are of similar interest either in ENP, or the broader Everglades ecosystem. As such, the research questions of this study are: where is the current distribution of suitable habitat for these species in Florida? Where will suitable habitat be distributed in the future? What factors are driving these changes? Will ENP change in suitability for any of these species due to climatic changes? This study correlates the georeferenced presence points of the different species in their native and non-native range and the current bioclimatic and hydrological variables at those sites using maximum entropy modeling (Maxent), in a species distribution modeling (SDM) framework. These relationships are then projected to two different representative concentration pathways (RCPs), further into the Anthropocene- the years 2050 and 2070.

The resulting maps of suitable habitat are reported at a 2.5 arc-minute resolution. Overall, suitable habitat is predicted to expand for most species, particularly those with warmer native ranges. For most species, canals continue to be suitable habitat, allowing for the seasonal colonization of surrounding wetlands from these deepwater refugia to continue in 2050 and 2070. For a minority of species, these novel features on the landscape become the only suitable habitat, presenting an opportunity for management. The strongest parameter in driving the distribution of suitable habitat was minimum temperature of the coldest month. For regions supporting rich fish diversity and endemism like the Southeastern United States, managers may use this SDM framework in prioritizing effort and limited resources in controlling those non-native species causing the most negative impacts.

BIO: Joe is a masters student whose research interests include species distribution modeling, invasion ecology, and invasive species management. He is especially interested in their intersection with climate change. He uses GIS and R to help address important questions in these fields.

Contact Information: Joseph Andreoli, Department of Geography, University of Florida, 330 Newell Dr., Gainesville, FL, USA, 32611, Phone: 786-489-0111, Email: josephaandreoli@gmail.com

A REVIEW OF SEAGRASS LOSSES AND ALGAL BLOOMS IN BISCAYNE BAY

Christian L. Avila, *Galia Varona, Maurice Pierre, Omar Abdelrahman, and Jamie Monty*
Miami-Dade County Department of Regulatory and Economic Resources Division of Environmental Resources Management (DERM), Miami, FL, USA

Miami-Dade County DERM has monitored seagrass and water quality in Biscayne Bay for over thirty years. Established in 1985, the benthic community monitoring program showed largely stable seagrass throughout the Bay, with only one seagrass loss event documented prior to 2005 and no significant phytoplankton or macroalgal blooms had occurred up until that point. Since 2005, there has been a succession of algal blooms and seagrass losses, with two significant phytoplankton blooms, and a macroalgal bloom. Although two of those blooms have been associated with large areas of seagrass loss, a recent decline of seagrass in a large area of Biscayne Bay has been observed in the absence of any algal bloom.

In chronological order, the earliest seagrass losses documented by this program occurred in North Bay in the late 90's. A fixed monitoring transect that had been dominated by *Syringodium,* since monitoring was established in 1985, died off in 1998. The station and surrounding area has not recovered seagrass since. In 2005, following a two year period of hypersalinity, a combination of mangrove removal and road construction practices coupled with Hurricane Katrina's freshwater and nutrient discharges resulted in seagrass losses and a multi-year phytoplankton bloom in the Southern Biscayne Bay basins, Barnes Sound and Manatee Bay. About the same time in 2005, a macroalgal bloom became apparent in the Northern-Central Inshore region of the Bay. This bloom rapidly developed and peaked in 2010-2012, resulting in a major loss of seagrass in the region. Following this the next notable event was a diatom phytoplankton bloom in 2013. The early onset of rainy season, and periods of heavy rain resulted in high flow from coastal control structures which increased nutrients loading. This bloom was short lived, lasting only two months, and no apparent seagrass losses were observed in association with this event. Mostly recently, losses of a dense area of *Syringodium,* in North Bay have accelerated. This event is currently being studied and no specific causal factors have been identified. Cumulatively the area of seagrass lost since 2005 across all of these events in Biscayne Bay is estimated to be 61km^2.

The significant loss of habitat and the increasing frequency of these events make it apparent that better predictive and protective measures are needed for Biscayne Bay. This review will tie together potential common elements of the recent events, which in turn may aid in identifying conditions associated with algal bloom risk and measures that may assist in taking steps to prevent algal blooms and seagrass losses in Biscayne Bay.

BIO: Christian Avila is a South Florida native. He attended Nova Southeastern University for his graduate and undergraduate degrees and has worked at Miami-Dade DERM for 18 years.

Contact Information: Christian Avila, Miami-Dade County Division of Environmental Resources Management, 701 NW 1st Ct, Miami, FL 33136, Phone: 305-372-6861, Email: avilac@miamidade.gov

AN UPDATE ON RECENT SALINITY AND SUBMERGED AQUATIC VEGETATION TRENDS IN NORTHEASTERN FLORIDA BAY

Damaso Rosales, Galia Varona, ***Christian Avila****, and Jamie Monty*
Miami-Dade County Department of Regulatory and Economic Resources Division of Environmental Resources Management (DERM), Miami, FL, USA

Miami-Dade County DERM submerged aquatic vegetation (SAV) monitoring program has established data records within the basins of southern most Biscayne Bay and northeastern Florida Bay dating back to 1993. Relative to this program, a number of specific climatologic events and physical trends have shaped the seagrass community within the northeastern embayments.

During 2015, the total annual discharge and total annual precipitation in the area were higher than in the previous year, but occurred mostly during the period September-December influenced by the strongest “El Niño” event since 1997/1998. Locally and region wide, the total precipitation during 2015 rain season was 30% below normal. Additionally, across South Florida, 2015 accounts for the Warmest Year on Record, a factor contributing to an increase of evaporation rates in the area. The annual average water temperature registered during 2015 DERM sampling in the study area was 27.16°C, similar to the temperature recorded during 2005. The abnormal timing of rain and freshwater discharge, along with warmer monthly temperatures, account for the increase in the 2015 mean salinity values (32.8 psu) relative to 2014 (30.1 psu). Both years registered the highest mean salinity values for the study area in the program’s long term Period of Record.

For the calendar year 2015, *Ruppia maritima* and the freshwater algae *Chara hornemannii* were absent from the study area, and this was first time both of these freshwater indicators were not observed by the program in a calendar year. Also a general decrease in *Halodule wrightii* was observed, with both average shoot density and coverage measurements (shoot/m^2 and BBCA) registering the lowest values in the Period of Record. This appears to be a reflection of the overall higher salinities during the 2015.

BIO: Damaso Rosales graduated from the University of Havana in 2003 He worked at the National Aquarium of Cuba until 2008. Since 2009 he has worked at Miami-Dade DERM or reef monitoring, SAV, and water quality programs.

Contact Information: Galia Varona, Miami-Dade County Division of Environmental Resources Management, 701 NW 1st Court, 5th Floor, Miami, FL 33136, USA, Phone: 305-372-6913, Email: Galia.Varona@miamidade.gov

ENHANCE IT AND THEY WILL COME – EVERGLADE SNAIL KITE UTILIZATION OF HABITAT MANAGEMENT AREAS ON LAKE OKEECHOBEE

Brent Bachelder[1] *and Tyler Beck*[2]

[1]Florida Fish and Wildlife Conservation Commission, Okeechobee, FL, USA
[2]Florida Fish and Wildlife Conservation Commission, Tequesta, FL USA

Lake Okeechobee is considered critical foraging and breeding habitat for the Federally Endangered Everglade Snail Kite (*Rostrhamus sociabilis plumbeus*). Snail Kite utilization is concentrated within the approximately 81,000 hectare near shore and littoral zones of Lake Okeechobee. However, Snail Kite activity patterns within Lake Okeechobee are highly dynamic and shift within and between years as a result of varying water levels, prey availability, and marsh vegetation patterns. Vegetation patterns – composition, distribution, and structure – in Lake Okeechobee's littoral zone marsh create challenges for successful Snail Kite utilization. Over the past 15 years the Florida Fish and Wildlife Conservation Commission and partner agencies have implemented various management strategies across approximately 16,000 hectares of marsh, many with the goal to improve Snail Kite habitat. These management activities target vegetation patterns and include: chemical herbicide treatment, prescribed fire, and organic sediment removal. One actively managed area within Lake Okeechobee is Moonshine Bay.

Historically, Moonshine Bay was an approximately 4,000 hectare spikerush (*Eleocharis cellulosa*) marsh and an important nesting area for Snail Kites. Over the past 40 years Moonshine Bay has transitioned into a densely vegetated cattail (*Typha* sp.) marsh; this is a result of eutrophication, water level stabilization and reduction of fire frequency. Due to this transition, Snail Kite nesting has greatly reduced in the area since 1989. The objective of habitat management in Moonshine Bay is to reduce coverage of dense monotypic cattail stands and increase the coverage of spikerush. The targeted conditions provide improved Snail Kite foraging habitat which in turn should result in increased likelihood of successful nesting opportunities. In 2015, herbicide treatments and prescribed fire were conducted across thousands of acres in Moonshine Bay to increase spikerush coverage in the marsh. The following (2016) Snail Kite nesting season on Okeechobee was possibly the most successful on record. A majority of that nesting – approximately 70% of all Lake Okeechobee nesting effort, more than 160 nests, with a preliminary success rate of 66% – was associated with 2015 vegetation treatments. Snail Kite nesting in Moonshine Bay during 2016 appears to be a response to habitat management activities. The response of Snail Kites to habitat management efforts on Lake Okeechobee in 2016 show the value of conducting active management for endangered species. These results also demonstrate the significance of basing management decisions on historic site conditions.

BIO: Brent Bachelder is a biologist with over ten years of wetland restoration and habitat management experience in the Northern Everglades watershed. He has been a project leader on dozens of projects from the Kissimmee Chain of Lakes to Lake Okeechobee and from the Kissimmee River to the Lake Wales Ridge.

Contact Information: Brent Bachelder, Florida Fish and Wildlife Conservation Commission, 3991 SE 27th Court, Okeechobee, FL, 34974, USA, Phone: 863-462-5190, Email: brent.bachelder@myfwc.com

EFFECTS OF RESTORATION ALTERNATIVES ON STAGES AND FLOWS IN THE SOUTHERN EVERGLADES, USING THE MIKE MARSH MODEL OF EVERGLADES NATIONAL PARK (M3ENP)

***Kiren Bahm**, Melody Hunt, Kevin Kotun and Gregg Reynolds*
South Florida Natural Resources Center, Everglades National Park, Homestead, FL, USA

A fully integrated, three-dimensional surface and subsurface hydrological model, the MIKE Marsh Model of Everglades National Park (M3ENP), was used to evaluate impacts of water management decisions on the hydrologic resources of Everglades National Park (ENP). This model incorporates the dynamics of overland flow, groundwater and open channel flow representing the extensive water control features of the South Dade Conveyance System (SDCS) adjacent to the park. Structural components represented in the M3ENP include existing and proposed components of the SDCS from the Modified Water Deliveries Project, the C-111 South Dade Project, and the South Dade Investigation.

The M3ENP was used to evaluate the effects of proposed structural and operational changes to the SDCS on stages, hydroperiods, and flows in ENP, and particularly into Taylor Slough, an important source of freshwater to Florida Bay. The modeling results from the M3ENP will be presented, and compared with results from the Regional Simulation Model for similar water management alternatives.

Bio: Kiren Bahm is a hydrologist at the South Florida Natural Resources Center, which serves the National Parks in South Florida. She performs hydrologic modeling and analyses of ecosystem restoration alternatives, primarily focused on Everglades National Park. Kiren has been at the South Florida Natural Resources Center for over eight years, originally joining the Park Service in 2005, and taking a 3-year hiatus to travel and work in risk assessment modeling.

Contact Information: Kiren Bahm, Everglades National Park, 950 N. Krome Ave, 3rd Floor, Homestead, FL 33134, USA,
Phone: 305-224-4218, Email: kiren_bahm@nps.gov

EFFECTS OF FLOW ON ENZYME ACTIVITY IN THE EVERGLADES STORMWATER TREATMENT AREAS

***Sara A. Baker*[1]**, *Patrick W. Inglett*[1], *Xiaolin Liao*[1], *Kanika S. Inglett*[1], *Kaylee Rice*[1], *Jill King*[2], *Kathy Pietro*[2]
[1]Wetland Biogeochemistry Laboratory, Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

In constructed wetlands like the Everglades Stormwater Treatment Areas (STAs), microbial processes play a key role in nutrient removal. Specifically, extracellular enzyme production regulates organic decomposition, nutrient mineralization, and indicate overall nutrient limitation. Hydrologic flow and its management directly effects nutrient distribution and loading, which likely alters microbial functions such as enzymatic activity; however, there are few studies that assess the effect of flow on enzyme activities. In this study, enzymes for P (phosphomonoesterase, APA and phosphodiesterase, BisP), C (β-glucosidase, BG), and N (Leucine aminopeptidase, LAP and β-N-acetylglucosaminidase, NAG) were analyzed at inflow, midflow, and outflow stations of STA 2 Cell 3 during stagnant, low, moderate, and high flow conditions. In general, enzyme activity increased from inflow to outflow, with the largest increases observed in P-related enzymes. Under flowing conditions, overall enzyme activity was stimulated and accompanied by higher microbial biomass, especially at the outflow. Increased microbial biomass and P-related enzyme activity indicates an effect of flow on microbial abundance and a potential role of flow in P limitation at the outflow. Comparing these results of microbial enzymes with water quality patterns and decomposition may better predict the role of microbial activity on nutrient limitation under stagnant and flow conditions.

BIO: Sara Baker is a senior undergraduate in Soil and Water Sciences at the University of Florida. In fall 2016, she began working on the STA project with Dr. Patrick Inglett, and she plans to continue to her research in graduate school studying Wetland Biogeochemistry.

Contact Information: Sara Baker, Wetland Biogeochemistry Laboratory, University of Florida, 2181 McCarty Hall A, Box 110290 Gainesville, Florida 32611, Phone: 352-256-4134, Email: sara.baker@ufl.edu

BRINGING THE CLASSROOM TO THE SCIENCE: HIGH SCHOOL INTERNSHIP IN EVERGLADES ECOSYSTEM ECOLOGY

Brian Benscoter[1]*, JoAnn Cantlupe*[2]*, and* ***John Baldwin***[2]

[1]Florida Atlantic University, Davie, FL USA

[2]South Plantation High School, Plantation, FL USA

Science-based solutions for society's environmental challenges require science-savvy researchers and practitioners and a science-literate electorate. Key to meeting this challenge is early engagement of students in STEM educational experiences, particularly through hands-on opportunities in the practice and application of environmental research. The mission of the South Plantation High School Magnet Program in Environmental Science and Everglades Restoration is to empower students to compete in the global marketplace in environmental science and technology, and to prepare students for real-world experiences including restoring Florida's Everglades. Recently, the Magnet Program partnered with faculty at Florida Atlantic University to develop a pilot student internship program enabling Magnet high school students to gain primary research experience in active University labs through supervised independent projects in Everglades science. Not only will this program help answer key questions in Everglades restoration but also provide invaluable practical experience for high school students preparing to enter their formative years of professional training.

In this internship, we are investigating the influence of altered hydrology on ecosystem carbon exchange by sawgrass (*Cladium jamaiscense*) through a manipulative experiment at the FAU-Davie Greenhouse. Individual culms of sawgrass were established in independent mesocosms and assigned to one of three hydrologic conditions: Inundated (soil surface water table), Flooded (+20cm water table), or Drought (-20cm water table). Closed chambers were used to measure headspace carbon dioxide concentrations during a 5 min incubation under full light and dark conditions. These data will be used to assess the degree to which plant photosynthesis and respiration are impacted by altered scenarios of Everglades hydrology.

<u>BIO</u>: Dr. Benscoter is Associate Professor of Wetland Ecology at Florida Atlantic University, with over 15 years of experience in the ecology and carbon cycling of peatlands. Mr. Baldwin is a Junior at South Plantation High School.

<u>Contact Information</u>: Brian Benscoter, Florida Atlantic University, 3200 College Ave, Davie, FL 33314, Email: bbenscot@fau.edu

APPLICATION OF THE COMPREHENSIVE AQUATIC SYSTEM MODEL (CASM) IN SUPPORT OF ECOSYSTEM RESTORATION

Steve Bartell[1,2]

[1]Cardno, Inc., Greenback, TN, USA
[2]University of Tennessee, Knoxville, TN, USA

The Comprehensive Aquatic System Model (CASM) is a spatially explicit, flexible food web – ecosystem modeling platform that provides the user with the capability to examine the ecological risks and benefits anticipated for alternative ecosystem restoration actions (e.g., habitat creation, managed flows and sediment distribution, water quality management). The user can specify multiple populations for individual trophic guilds of primary producers and consumers, as well as riparian mammals and birds, consistent with overall modeling and restoration objectives. The CASM simulates daily values of biomass (carbon) of the modeled populations as functions of population-specific bioenergetics and dynamic physical-chemical and hydrological environmental factors that influence population growth. The CASM summarizes potential changes in community structure and ecosystem function (e.g., energy flows, nutrient cycling, decomposition, carbon sequestration) as expected outcomes of alternative management actions. The CASM permits examination of the potential implications of multiple stressors (e.g., nutrient enrichment, hypoxia, temperature and salinity extremes, and invasive species) on the likely success of proposed management alternatives. The modeling platform uses Monte Carlo methods to characterize the potential impacts of environmental variability and parameter uncertainty on model results. The presentation will outline the structure and use of the CASM to support proposed ecosystem restoration in South Florida and describe previous site-specific applications of the model to inform the adaptive management of aquatic ecosystems throughout the United States.

BIO: Dr. Bartell is a Principal in Cardno with more than 30 years of experience in the development, application, and analysis of ecological models. He has extensive experience with using models to explore wetland ecosystem restoration, resource management, and habitat creation in coastal systems, including the Florida Everglades.

Contact Information: Steve Bartell, Cardno, Inc., PO Box 124, Greenback, TN, USA 37742, Phone: 865-271-8107, Email: steve.bartell@cardno.com

ENGAGING SOCIETY IN EVERY STEP OF THE SCIENTIFIC PROCESS: A PLEA FOR NEW EXTENSION APPROACHES

Mathieu Basille
Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, University of Florida, Davie, FL, USA

In a world full of environmental threats and challenges, it is more important than ever to conduct relevant science, but also critical to distribute scientific outputs to all levels of society. In this talk, I will introduce my Extension program, which aims to inform, train and involve society on the critical impact of humans on the spatial distributions of animal species. The following Extension examples are presented as a platform for discussion, in order to extend Extension techniques and embrace new communication methods.

The first example follows a traditional approach of Extension, in which written documents play a key role. Documenting landscape-scale changes and their consequences on wildlife is approached through a series of publications intended for the general public, as well as special communications for a technical audience (such as stakeholders and professionals directly involved in science). In-Service Training for county agents complements this to provide an interface between academia and society.

The second example relies on involving the general public in a citizen-science event through Bioblitzes, which are intense periods of biological survey in an attempt to record all living species within a designated area. In an effort to inform and raise awareness of the general public about wildlife in their immediate environment, volunteers of all ages will explore hands-on science and nature activities with working scientists. Participants will be fascinated by what is discovered in parks nearby, potentially including rare species, while contributing to monitoring biodiversity.

Finally, a third example shows how workshops can be effective tools to train science and technical staff of governmental and non-governmental organizations in highly specialized, but critically important fields. I propose workshops for the analysis of spatial data in various formats, from one-day intensive workshops designed to present an overview of state-of-the-art techniques and tools, to weeklong workshops designed to fully support hands-on practice with movement data, from management and storage to retrieval for analyses.

BIO: Dr. Basille is an Assistant Professor working in Landscape Ecology. He studies the determinants of animal distribution and movement to inform management and conservation of threatened and endangered species. He is notably involved in projects dedicated to wood stork, sea turtles and American crocodiles in Florida.

Contact Information: Mathieu Basille, Fort Lauderdale Research and Education Center, 3205 College Avenue, Davie, FL 33314, USA, Phone: 954-577-6314, Email: basille@ufl.edu

CAPE SABLE SEASIDE SPARROW DECISION SUPPORT TOOLS FOR WATER MANAGEMENT

James Beerens[1]*, Bryan McCloskey*[2]*, Mark McKelvy*[3]*, Stephanie Romañach*[1]*, Paul Conrads*[4]
[1] U.S. Geological Survey, Davie, FL, USA
[2] Cherokee Nation Technology, contractor to U.S. Geological Survey, St. Petersburg, FL, USA
[3] U.S. Geological Survey, Lafayette, LA, USA
[4] U.S. Geological Survey, Columbia, SC, USA

The Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) is endemic to south Florida and a key indicator species of marl prairie, a highly diverse freshwater community in the Florida Everglades. Historically, the location of marl prairie patches in the Everglades landscape shifted in response to changing hydroclimatic conditions; however, habitat loss and hydrologic alteration now restrict the range of this habitat, thereby narrowing the sparrow's range and increasing their sensitivity to changing hydropatterns. As a result, sparrow numbers have declined as much as 60 percent range-wide since 1992. Because this nonmigratory bird is restricted in its range, it was among the first species to be listed as endangered by the U.S. Fish and Wildlife Service (FWS) in 1967, and the marl prairies in which is resides are listed as critical habitat.

In 2014, range-wide surveys conducted by Everglades National Park indicated the sparrow population (2,720 individuals) fell below a key threshold level (2,915), thereby requiring the U.S. Army Corps of Engineers (USACE) to reinitiate consultation, under the Endangered Species Act, on the Everglades Restoration Transition Plan, a regional operation plan for water management.

Two U.S. Geological Survey (USGS) tools, the Sparrow Viewer and the Sparrow Helper, were used to provide decision support for the consultation process. The Sparrow Viewer, an online Everglades Depth Estimation Network (EDEN) application, evaluates daily water depths in the six sparrow subpopulation habitats on a real-time basis. The animated viewer shows flooded areas and displays metrics that the U.S. Fish and Wildlife Service uses to determine if targets for sparrow management are being met. The Sparrow Helper, a Joint Ecosystem Modeling (JEM) software application, provides analyses of water management scenarios; generating, plotting, and mapping metrics across a range of time scales to help understand impacts of proposed water depth changes to sparrow subpopulations.

The presentation will highlight the capabilities of each USGS tool and demonstrate how the derived hydrologic metrics (short- to long-time scales) are related to sparrow occurrence over the EDEN period of record (1991-2017).

BIO: James Beerens is an Ecologist at the USGS Wetland and Aquatic Research Center (WARC). He also serves as a lead developer of ecological applications for the Everglades Depth Estimation Network (EDEN). James has developed decision-support applications, ecological models, and visualization software for the Joint Ecosystem Modeling (JEM) community.

Contact Information: James M. Beerens, Wetland and Aquatic Research Center, U.S. Geological Survey, 3321 College Ave., Davie, FL 33314 USA, Phone: 954-377-5934, Email: jbeerens@usgs.gov

HABITAT SELECTION OF THE BURMESE PYTHON IN THE FLORIDA EVERGLADES

***James Beerens**[1], Kristen Hart[1], Brian Smith[2], Ikuko Fujisaki[2], Mike Cherkiss[1]*
[1]U.S. Geological Survey, Davie, FL, USA
[2]University of Florida, Davie, FL, USA

The Burmese python poses an ongoing threat to the integrity and functions of the Everglades ecosystem and native wildlife, but little is known about their habitat preferences. Models based on daily movements when coupled with daily changes in wetland habitat condition (e.g., hydrology, proximity to resources, temperature) provide a powerful management tool for predicting the spatial and temporal distribution and potential habitat expansion of the species.

Locations of radio-tagged pythons were plotted on a map of the Everglades using a GIS. For each python, straight-line vectors were created between each observed location and the sequential location. We assumed that a python could have traveled that distance in any direction, therefore a buffer of the 'maximum' distance traveled was drawn to represent available habitat during the time interval. Locations within 50-m of a previous location were excluded because variables at random locations could not be discriminated from variables at used locations; sequential locations greater than 10,000-m were excluded to limit the influence of long time lags between observations. Within the buffer, random points were generated to compare habitat variables at used locations to those at random locations. We estimated habitat selection for pythons across the study period using resource selection functions (RSFs) and a stratified Cox proportional hazards likelihood maximization routine, which allows available resource units to change daily. RSFs yield values proportional to the probability of use of a resource unit (0-1).

Results demonstrated python selection for wetland sites that had been inundated for ~400-500 days, but were still within close proximity to upland features such as tree islands. When maximum temperatures were low (70^{o}F), pythons demonstrated greater selection for upland features, but in higher maximum temperatures were less likely to be near uplands. In general, pythons preferred stable temperatures (small difference between maximum and minimum temperature). Pythons also tracked ideal depth conditions across the landscape, selecting more rapid recession rates when water depths were high.

These models will greatly improve our ability to predict where and when to target control efforts to limit the expansion of this invasive species.

<u>BIO</u>: James Beerens is an Ecologist at the USGS Wetland and Aquatic Research Center (WARC). He also serves as a lead developer of ecological applications for the Everglades Depth Estimation Network (EDEN). James has developed decision-support applications, ecological models, and visualization software for the Joint Ecosystem Modeling (JEM) community.

<u>Contact Information</u>: James M. Beerens, Wetland and Aquatic Research Center, U.S. Geological Survey, 3321 College Ave., Davie, FL 33314 USA, Phone: 954-377-5934, Email: jbeerens@usgs.gov

THE SENSITIVITY OF EVERGLADES SPECIES MODEL PREDICTIONS ACROSS NEAR-TERM DEPTH FORECASTS

James Beerens[1], *Leonard Pearlstine*[2], *Mark McKelvy*[3], *Kevin Suir*[3], *Stephanie Romañach*[1], *Gregg Reynolds*[2]
[1]U.S. Geological Survey, Davie, FL, USA
[2]National Park Service, Homestead, FL, USA
[3]U.S. Geological Survey, Lafayette, LA, USA

Ecological models are used in the Everglades to help forecast potential ecological outcomes to proposed restoration projects; however, these models are evaluated independently and not integrated into a quantitative decision support framework. Further, ecological metrics to measure restoration success (i.e., performance measures) are evaluated periodically over the long-term, even though nearly real-time water depth and ecological data are readily available for ecosystem management decisions.

The Everglades Forecasting (EVER4CAST) application is being developed to forecast integrated ecological responses to anticipated, short-term hydrologic conditions. This spatially-explicit quantitative application allows decision makers to identify regional management actions that can benefit a suite of ecological communities, while quantifying the potential costs to others (e.g., endangered species, wading birds, prey fishes, seagrasses, and landscape responses).

Six-month water depth forecasts are generated using NOAA monthly precipitation forecasts and historical depth change distributions using the Everglades Depth Estimation Network (EDEN). For sensitivity testing, we produced a set of probabilistic water depth forecasts for the dry season of 2016 and demonstrated predicted species responses across two axes of interest in water management: mean water depth and variation in the drying pattern. Further, we characterized the variation in species responses within and across each of four quadrants (high water/high variability, high water/low variability, etc.) to determine species sensitivity to each. Predicted avian abundance was highest in the low water/low variability forecasts, whereas fish density and python suitability were highest under the high water/high variability forecasts.

In light of growing concern over the frequency and severity of episodic weather events, near-term forecasts of hydrologic conditions and an integrated evaluation of ecological responses can help guide real-time decision-making and long-term restoration planning.

BIO: James Beerens is an Ecologist at the USGS Wetland and Aquatic Research Center (WARC). He also serves as a lead developer of ecological applications for the Everglades Depth Estimation Network (EDEN). James has developed decision-support applications, ecological models, and visualization software for the Joint Ecosystem Modeling (JEM) community.

Contact Information: James M. Beerens, Wetland and Aquatic Research Center, U.S. Geological Survey, 3321 College Ave., Davie, FL 33314 USA, Phone: 954-377-5934, Email: jbeerens@usgs.gov

SALINITY IN BISCAYNE BAY AND THE BISCAYNE BAY COASTAL WETLANDS

Sarah Bellmund[1]*, Herve Jobert*[2]*, Jorge Robles Baneres*[2]*, Joan Browder*[3]*, Joe Serafy*[3]*, and Diego Lirman*[2]

[1] Biscayne National Park, Homestead, FL, USA
[2] University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL, USA
[3]National Marine Fisheries Service, Miami, FL, USA

Salinity in Biscayne Bay and Biscayne National Park is controlled by inflow of freshwater from canal flow, groundwater from the Biscayne Aquifer, rainfall, and some overland flow. In 2004 sampling sites were installed for continuous in-situ benthic salinity and temperature readings to understand downstream salinity conditions and responses to water management. In 2013 combined sampling with biotic sampling was established in the Integrated Biscayne Bay Ecosystem Assessment and Monitoring (IBBEAM) Program. The data demonstrate that estuarine conditions exist along the shoreline mostly in the wet season but are not distributed equally along the shoreline and depend upon upstream operations of the canal systems. Restoration of healthy nursery conditions for estuarine organisms will require redistribution of water flow into the Bay to areas receiving little flow currently. During the period from 2009 to present, several water flow test operations have been run. These operations suggest that lowering salinity during the early dry season and holding it as low as practical helps maintain lower salinity in the late dry season. This allows bay salinity to recover faster and better spread the positive effects of freshwater inflow. The distance offshore and duration of low salinity will be analyzed to identify periods of altered operations of the coastal canal system and their effect on bay salinity. These data will be used to provide recommendations for new operations in the upstream areas of the Biscayne Bay Coastal Wetlands Project as part of the Comprehensive Everglades Restoration Plan. Record rainfall in the dry season of 2015-2016 provides a potential interim target for water flow and downstream salinity conditions in Biscayne Bay. It also provides an opportunity to compare existing conditions, water delivery operations tests, and an extreme natural event to identify potential interim targets toward restoration of estuarine salinity conditions and healthy nursery habitat.

BIO: Sarah Bellmund is an ecologist with National Park Service at Biscayne National Park with 29 years of experience working on restoration in south Florida. She is the Program Manager for Water Quality and Adjacent Lands at Biscayne National Park where she is the technical lead on Everglades Restoration.

Contact Information: Sarah Bellmund, Biscayne National Park, 9700 SW 328th St. Homestead, FL 33037, Phone: 786-335-3624, Email: sarah_bellmund@nps.gov

ASSESSING THE ROLE OF FIRE DISTURBANCE IN MAINTAINING CAPE SABLE SEASIDE SPARROW (*AMMODRAMUS MARITIMUS MIRABILIS*) HABITAT USE

***Allison M. Benscoter*[1]**, *James M. Beerens*[1], *Stephanie S. Romañach*[1], *Leonard Pearlstine*[2]
[1]U.S. Geological Survey, Fort Lauderdale, FL, USA
[2] Everglades National Park, Homestead, FL, USA

The Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*, hereafter sparrow*)* is endemic to south Florida, and an important indicator species of marl prairie habitat. Changes in water flow through the Everglades have resulted in detrimental changes to sparrow habitat, and sparrow numbers have decreased by as much as 60% since 1992. Because marl prairie is a critical habitat for this endangered sparrow, and supports the most diverse freshwater community in the Florida Everglades, it is important to elucidate the factors comprising suitable habitat for sparrows. Marl prairie community is supported by intermediate levels of disturbance such as drying, flooding, and fire, and located in short-hydroperiod areas inundated for 4-6 months out of the year. Sparrows prefer to nest in vegetation at a mean height of 14-18 cm, and nests are often lost to predators when water levels rise above 10 cm, making the time of early high water levels important. However, the direct role of fire in maintaining suitable habitat for sparrow use is less clear.

Evidence suggests that sparrows may return to marl prairie 3 years after a fire, but vegetation recovery can take many more years, particularly if re-flooding occurs rapidly post-burn. Here, we will use daily sparrow distributions from 1991-2015 to investigate the association between fire disturbance and sparrow occurrence on a landscape-scale. Sparrow surveys were conducted by helicopter visits to sites (on a 1 km grid) that included any potential sparrow habitat, and all sparrows detected over a 7 minute interval within an approximately 200 meter radius of each location were recorded. Fire data were obtained from the Fire Geodatabase for Everglades National Park and LANDFIRE program.

In this study, we examine the interval over which habitat is recolonized by sparrows following fire disturbance. We also examine sparrow occurrence in relation to the fire severity and the percent of cell burned. We predict that recolonization is delayed in areas with increased fire severity, and that recolonization occurs more rapidly along the periphery of a burn (e.g., cells not completely burned). Ultimately, these relationships will be used in the larger context of species distribution modeling, that incorporate a suite of environmental and biological variables to understand the most important factors for maintaining viable sparrow populations across the landscape.

BIO: Allison M. Benscoter is an Ecologist for the U.S. Geological Survey, who focuses on science and tools for ecological restoration and the conservation of wildlife. Allison's primary areas of interest include including understanding spatial patterns of wildlife across space and time and investigating species-specific habitat and environmental relationships, in particular in relation to factors such as climate change, ecological restoration, and other abiotic and biotic impacts.

Contact Information: Allison M. Benscoter, U.S. Geological Survey, Wetlands and Aquatic Research Center, 3321 College Avenue, Fort Lauderdale, FL 33314, USA, Phone: 954-377-5964, Email: abenscoter@usgs.gov

EFFECTS OF FRESHWATER ACIDIFICATION ON MICROALGAE GROWTH RATES AND PIGMENT-BASED CHEMOTAXONOMY

Jeanne Bermudez *and J. William Louda*
Florida Atlantic University, Department of Chemistry and Biochemistry, Boca Raton, FL USA

The purpose of this research relates to the effects of global warming on fresh water acidification due to high levels of Carbon Dioxide (CO_2). This research will focus on the effects of freshwater acidification on microalgal growth rates, emphasizing potential alterations of pigment contents and internal ratios as applied to pigment-based chemotaxonomy.

This research will be carried out through analysis and classification of pigments found within the algal populations. This is because phytoplankton and algae are often classified and analyzed based on the characteristics and concentration of the pigments that are found within the organism, as these pigments often are unique to a certain species. The most common pigment groups found within algae and phytoplankton are the chlorophyll and carotenoid pigments. Chlorophyll pigments are defined as green pigments that are present in photosynthetic organisms; the most common chlorophylls are chlorophylls-a, b, c, and d. Carotenoids are defined as pigments that vary from yellow to red; the most common carotenoids are carotenes and xanthophylls. Pigments are unique due to their capability of absorption of electromagnetic radiation in the ultra violet-visible (UV-VIS) spectrum, and conversion of this light energy into metabolic energy.

The procedures of this experiment include measurements of pH levels using an electrode probe, cell counting using a Hemocytometer, and analysis of chemotaxonomy of the algae present using High Performance Liquid Chromatography (HPLC) and UV-VIS spectroscopy. HPLC allows for the separation and classification of the pigment groups associated within a given species of algae.

The results of this experiment will provide information regarding the relative population of different algae species that are capable of survival at various carbon dioxide levels giving insight to the effects global warming will have on marine life.

BIO: Jeanne Bermudez is completing her Masters degree in Chemistry with a focus on Environmental Chemistry at the Department of Chemistry and Biochemistry at Florida Atlantic University.

Contact Information: Jeanne Bermudez, Dr. J William Research Group, 777 Glades Rd, Boca Raton, FL, USA 33431,Phone: 305-815-4755, Email: jbermud2@fau.edu

OCCURRENCE OF APPLE SNAILS BEYOND THE SHALLOW MARSH

Jennifer Bernatis
Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

Fluctuating populations of native and non-native apple snails (*Pomacea* spp.) pose a particular concern to managers tasked with developing recovery plans for the endangered Everglades Snail Kite (*Rostrhamus sociabilis plumbeus*). While reasons for snail population fluctuations remain unclear, changes in water levels (primarily lowering water levels) and the subsequent changes in available snail habitat are likely explanations. The majority of population surveys, which have focused on *Pomacea paludosa*, propose a preference for water < 0.5 m deep. During the last decade, observations have been made for both *P. paludosa* and *P. maculata*, in lentic and lotic environments, suggesting surveys in deeper water may be necessary to explain population fluctuations. These records provide examples of *P. paludosa* and *P. maculata* occurring in a variety of aquatic ecosystems and at depths ranging from < 0.1 m to 14.6 m. The data also include results of an ongoing study in East Lake Tohopekaliga where the majority of the snails have been collected in sparsely vegetated areas at depths > 0.75 m to 2.25 m in open water/bare sediment. Therefore, this data suggests that in areas where *Pomacea* spp. appear to be rare or absent from shallow habitats (< 1.0 m), surveys in deeper waters should be conducted as the snails do occupy deeper waters.

BIO: Dr. Bernatis is a Biological Scientist with more than 15 years of experience in freshwater and marine ecology and invertebrate physiology. She has extensive experience with designing ecological studies for freshwater invertebrates, and animal response level physiological experiments for invertebrates.

Contact Information: Jennifer Bernatis, Florida Fish and Wildlife Conservation Commission, 7386 NW 71st St., Gainesville, FL, USA 32653, Phone: 352-415-6954, Email: Jennifer.bernatis@myfwc.com

PHOSPHORUS MANAGEMENT THROUGH SUSTAINABLE AGRICULTURAL PRACTICES IN SOUTH FLORIDA

Jehangir H. Bhadha*[1]*, *Timothy A. Lang*[1]*, Samira H. Daroub*[1] *Mohsen Tootoonchi* [2]*, Odiney Alvarez*[3]*, Jay Capasso*[1]
[1]University of Florida, Everglades Research and Education Center, FL, USA
[2]University of Florida, Fort Lauderdale Research and Education Center, FL, USA
[3]Virginia Tech University, Blacksburg, VA, USA

Soil sustainability, water conservation and nutrient management are the cornerstone of sustainable agriculture. In the Everglades Agricultural Area (EAA) and C139 basin of South Florida, farming practices have long been mindful of phosphorus (P) management as it relates to sufficiency and efficiency of P utilization. Over two decades of P best management practices have resulted in 3001 metric-ton of P load reduction from the EAA to downstream ecosystems. Research is being conducted on organic and sandy soils to improve efficiency of P uptake and minimize discharge loads.

During the summer, more than 50,000 acres of fallow sugarcane land is available for rice production in the EAA. The net value of growing flooded rice in the EAA as a rotational crop with sugarcane far exceeds its monetary return. Soil conservation, pest control, and P load reduction are only some of the benefits. With no P fertilizer applied, a two-year field trial on flooded rice showed reduced outflow P concentrations by up to 40% as a result of particulate setting and plant P uptake. Harvested whole grain rice can effectively remove 15 kg ha^{-1} of P from a rice field per growing season.

In parts of the EAA and C139 basin where soils are sandy, the application of using locally derived organic amendments as potential P fertilizer has gained interest over the past few years. The use of local agricultural and urban organic residues as amendments in sandy soils of South Florida provide options to enhance soil properties and improve sugarcane yields, while reducing waste and use of inorganic fertilizers. A lysimeter study was conducted to determine the effect of mill ash and three biochar types (rice hulls, yard waste, horse bedding) on sugarcane yields, soil properties, and drainage water quality in sandy soils. Mill ash and rice hull biochar increased soil TP, Mehlich 3-P (M3-P), and cation exchange capacity (CEC) compared to the control. TP and M3-P content remained constant after 9 months, however, CEC showed a significant increase over time with rich hull biochar addition.

Future projects include the utilization of aquatic vegetation as bio-filters in farm ditches to reduce P load. This will be achieved by circulating high P concentration farm canal water through the ditches prior to being discharged off site. Optimizing the flow through the ditches will allow the aquatic vegetation to uptake P. The vegetation will ultimately be harvested and incorporated back on to the fields.

BIO: Dr. Bhadha is an Assistant Professor at the Soil and Water Sciences Department at the University of Florida Everglades Research and Education Center. His research priorities include using soil, water, and nutrient management strategies to promote sustainable agriculture in South Florida.

Contact Information: Jehangir H. Bhadha, UF-IFAS Everglades Research and Education Center, 3200 E. Palm Beach Road, Belle Glade, FL, USA 33430, Phone: 561-993-1711, Email: jango@ufl.edu

NUTRIENT STORAGES IN THE EVERGLADES STORMWATER TREATMENT AREAS

***Rupesh K. Bhomia*[1]**, *Todd Osborne*[1], *Odi Villapando*[2], *and K. R. Reddy*[1]
[1]University of Florida, Gainesville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

Nutrient storages in the Everglades stormwater treatment areas (STAs) is influenced by hydraulic and nutrient loading, vegetation and associated biogeochemical processes. The main objective of this study was to determine the influence of vegetation type on accumulation of macro elements in soils and regulation of nutrient outflow concentration in the STAs. In STA-2, two flow ways with different vegetation types were used: Cell 1 with emergent aquatic vegetation (EAV) and Cell 3 with submerged aquatic vegetation (SAV). Intact soil cores were collected from pre-determined locations in each flow-way, separated into litter, floc, recently accreted soil (RAS), and pre-STA soil, and analyzed for selected physicochemical properties. Spatial patterns in concentration and storage of phosphorus (P), carbon (C), nitrogen (N), and sulfur (S) in these flow-ways were evaluated

Total P in the EAV cell (Cell 1) floc was substantially higher and more spatially extensive in comparison to the SAV cell (Cell 3) with approximately 50% of sampled sites having TP content > 750 mg kg^{-1}. Floc TP concentration was generally higher than RAS in both cells. Overall, P, C, N, and S storages were typically higher in the SAV cell in comparison to EAV cell. Calcium (Ca) accumulation in soils of the SAV cell was three-fold higher than in the EAV cell. This may be due to photosynthetic activity of dense submerged vegetation causing pH fluctuations that regulates Ca precipitation in the wetlands.

Accumulation of refractory organic material resulting in accretion of soil provides a long-term sink for P in STAs. This study provides insight into existing nutrient storages spatially and along the vertical soil layers in order to evaluate the influence of vegetation types and nutrient loading. Such insights are crucial for understanding the detailed biogeochemical processes that take place at soil-water interface and the short and long-term influence of stored P on STA outflow concentrations.

BIO: Dr. Bhomia is a trained wetland biogeochemist with research interests in nutrient cycling in inland freshwater wetlands and coastal ecosystems. Currently, Dr. Bhomia is a member of a team of scientists evaluating biogeochemical processes and factors influencing internal P loading in the Everglades STAs, as part of the Restoration Strategies Science Plan.

Contact Information: Rupesh K Bhomia, Wetland Biogeochemistry Laboratory, Soil and Water Sciences Dept., University of Florida, Gainesville, FL 32611. Email: rbhomia@ufl.edu

FISH IN MARL PRAIRIES- DISTURBANCE SEVERITY, INVASIONS, TRAITS AND EMERGENT COMMUNITY STRUCTURE

Jesse R. Blanchard *and Jennifer S. Rehage*
Florida International University, Miami, FL, USA

In the southern Everglades' marl prairies, solution holes can serve as longer hydroperiod refugia where fishes congregate during the dry season. However, due to the increased length and severity of dry down in the Rocky Glades (RG) marl prairie, the functionality of these refugia has been greatly diminished. Given that very few solution holes provide access to water throughout the dry season, and competition over limited resources, individual fish must make an informed settlement decision if they are to survive. We asked what abiotic factors drive assembly of these patch communities and which traits of individual fish are most influential on the assembly process. Given the dynamic nature of inter-annual hydrology in this region, we also asked how the severity of hydrologic disturbance (hydroperiod) influences the relative importance of each factor in driving metacommunity assembly.

In this study we used backpack electrofishing to sample RG solution holes to depletion when they first became disconnected from the marsh surface for three consecutive hydro-years (2013-2015). Holes were selected to represent the complete variation of key local factors (i.e. depth, surface area, etc.) in each of five functional hydrologic regions between Shark River and Taylor Slough. We also measured the regional factors of distance to Shark River Slough, and the regional hydroperiod. The ten individual traits used in this study were in the functional categories: life-history, competitive, anti-predation and dispersal related. Each studied year was hydrologically distinct (prolonged dry-down, contemporary normal, and a rapid recession), allowing for the evaluation of assembly across varying levels of dispersal limiting disturbance. We used a Hellinger transformation on the abundance data and performed a series of redundancy analyses to determine which factors drove assembly in each year. In the wettest year assembly was driven primarily by competitive traits and to a lesser extent by local abiotic factors, while the rapid recession year was primarily driven by regional scale factors such as hydrology and distance to Shark River Slough. The 'more normal' year was a mix of the two. Regional scale factors and competitive traits were both important; however, life history traits also became influential.

These results demonstrate the dynamic nature of fish metacommunity assembly in the southern Everglades, and raise some interesting points for consideration. As we restore the hydrology of the Everglades to meet certain goals, such as enhancing Cape Sable Seaside Sparrow nesting habitat, there will inevitably be unforeseen consequences. Reducing water levels in some areas will contract fish habitat with the communities becoming less competitively structured. Increasing water levels, however, may enhance the spatio-temporal effect of interspecific competition. This is particularly important when considering the highly invaded nature of the RG, and that many natives are poor competitors relative to the many highly aggressive cichlid invaders like African Jewelfish and Mayan Cichlids. As fish are central to the Everglades food-web, and their spatio-temporal distribution influences nearly all other taxa in the ecosystem, understanding how all management actions impact them is essential to restoring the system beyond key management goals.

<u>BIO</u>: Jesse is a doctoral candidate whose broad research focus is the multiple dimensions of invasion impacts on fish communities. His dissertation discusses Rocky Glades fish metacommunity assembly, and he is also working to understand how the broader Florida non-native fish epidemic will be impacted by climate change.

<u>Contact Information</u>: Jesse Blanchard, Florida International University, 11200 SW 8th St., Miami, FL, USA 33199, Phone: 304-348-0181, Email: BlanchJe@fiu.edu

OPTIMAL CONTROL OF AN INVASIVE SPECIES USING A REACTION DIFFUSION MODEL AND LINEAR PROGRAMMING

Mathieu Bonneau[1], *Fred A. Johnson*[2], *Brian Smith*[1], *Christina M. Romagosa*[1], *Julien Martin*[2], *Frank Mazzotti*[3]
[1]University of Florida, Dept. of Wildlife Ecology and Conservation, Gainesville, FL USA
[2]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL USA
[3]University of Florida, Dept. of Wildlife Ecology and Conservation, Davie, FL USA

Control of an invasive species is particularly challenging as little is generally known about the species' biological characteristics in its new habitat. In practice, removal of individuals often starts before the species is studied to provide the information that will later improve control. Therefore, the locations and the amount of control have to be determined in the face of great uncertainty about the species characteristics and with a limited amount of resources. We propose framing spatial control as a linear integer programming optimization problem. We use this framework to study the spatial control of the Argentine black and white tegus (*Salvator merianae*) in South Florida. This formulation, paired with a discrete reaction-diffusion model, permits calculation of an optimal control strategy minimizing the number of tegus for a fixed cost or the minimal control cost achieving containment. We propose computing the optimal strategy for a range of possible model parameters, representing the current uncertainty on tegus dynamic of invasion and demography. Each model represents a possible scenario of the tegu's invasion. Then, a best strategy can be calculated, depending on the risk attitude of the decision maker. For a fixed budget and a one-year time frame, we show that risk-averse and risk-neutral strategies were similar and that they concentrated control close to the presumed point of introduction. A risk-seeking strategy (i.e., one that seeks a highly favorable outcome that has a relatively low probability) consists of spreading control as much as possible because it focuses more on scenarios where eradication of the species in a cell is still possible. For the establishment of a containment area, we show that with current control methods it might not be possible to implement such a strategy for some of the scenarios that we considered. Including different possible scenarios in an analysis allows an examination of how the strategy is expected to perform in different scenarios. Then regarding all possible scenarios, which are possible representations of reality, a strategy that accounts for the risk attitude of the decision maker can be designed.

BIO: Dr. Bonneau was a former Post-Doctoral Associate at the University of Florida, and is now with the National Institute for Agricultural Research in Guadeloupe, France. His interests are in mathematical modeling and optimal decision making for the management of living resources.

Contact Information: Mathieu Bonneau, INRA, Unité URZ, Domaine Duclos, 97170 Petit-Bourg, Guadeloupe, France,
Email: mathieu.bonneau@antilles.inra.fr

INFLUENCE OF AN EXPERIMENTAL SHEET FLOW REGIME ON AQUATIC FOOD WEBS OF THE CENTRAL EVERGLADES

Sarah Bornhoeft[1], *Barry Rosen*[2], *Susan Newman*[3], *Colin Saunders*[3], *and Joel Trexler*[1]
[1]Florida International University, Miami, FL, USA
[2]U.S. Geological Survey, Orlando, FL USA
[3]South Florida Water Management District, West Palm Beach, FL USA

Restoration of the Florida Everglades seeks to re-create historical quality, quantity, timing, and flow of water, which may influence energy flow and food web function. The DECOMP Physical Model (DPM) provides an experimental study of elevated water-flow velocity in an area of the Everglades enclosed by levees and lacking surface flow for over 50 years. We hypothesized that elevated water-flow velocity in the DPM can indirectly impact the origins of organic matter by nutrient loading to biofilms, changing their quality as food (stoichiometry, species composition, and edibility), and cascading up to consumers through dietary impacts on body condition. We used fatty acids (FA) as dietary tracers to document how elevated water-flow velocity may alter the relative detrital and autotrophic contribution of energy to primary and secondary aquatic consumers. We conducted a laboratory diet-switching experiment to confirm that FA markers were incorporated in consumer tissues unchanged from their diet, and that they turn over in consumer tissue fast enough to be detected in a three-week field experiment. We tested our hypothesis of nutrient loading effects on primary producers and consumers in the DPM before (October 2014) and after (November 2014) introduction of flowing water.

In the laboratory, FAs in the tissues of common Everglades consumers, Sailfin Molly (Poecilia latipinna), Eastern Mosquitofish (Gambusia holbrooki), and riverine grass shrimp (Palaemonetes paludosus), were reflective of changing diets. FA turn-over was observed in less than 3 weeks, making FAs a sensitive dietary tracer. However, tissue turn-over was faster for a high-protein animal diet than for a low-protein vegetable diet. These results were similar to results from a comparable study of stable isotopic markers, but FA tracers provide more specific information about diet sources.

In the field study, periphyton and biofilm taxonomic composition were different for pre-flow and flow sampling, most clearly indicated by increases in the nutrient exploiting Mougeotia sp. (green algae) following three weeks of experimental flows. Stoichiometric analysis of biofilms indicated an increase in P with flow as expected from nutrient loading. Dietary tracer FAs changed in consumers, especially herbivorous Sailfin Mollies, which reflected the changes in the basal resources, including an increase in green algae FA markers and a decrease in bacteria-derived FAs. These food web responses indicate that elevated water flow velocity shifts basal resources of the food web from a more detrital (brown) to more algal (green) dominated web, probably as an effect of nutrient loading without a change in water P concentration. These changes in the basal resources were quickly transmitted to the consumer web and were detectable within three weeks in our experimental conditions.

BIO: Ms. Bornhoeft is a Scientist II with a state agency. This work was conducted as part of the requirements for an M.S. degree in the Department of Biological Science at Florida International University.

Contact Information: Sarah Bornhoeft, 6600 Cypress Rd. Apt 303, Plantation, FL 33317, Phone: 410-739-9304, Email: sb09262@gmail.com

A MARKOVIAN APPROACH TO MODELING BALD EAGLE DYNAMICS TO IDENTIFY LONG-TERM CHANGES IN TERRITORY USE IN FLORIDA BAY

Jason W. Bosley
Florida Atlantic University, Davie, FL, USA

Long-term monitoring programs provide a unique opportunity to explore more specialized modeling approaches that are otherwise limited by the availability of data. Maintaining within breeding season data on territory use, we identify how patterns have changed across decade long periods. Despite historical stability, Bald Eagle territory use in Florida Bay, Everglades National Park has declined while year to year variability has increased. We describe these changes in territory dynamics using a Markov chain model based on observed frequencies of territory use collected from a long-term monitoring program initiated in 1958. Over the monitoring period, a total of 43 annual transition matrices were created, considering four potential states (unoccupied, occupied, active, or successful). Perturbation analysis comparing transition matrices from two periods, 1960-75 and 1995-10, shows the distribution of successful territories is more sensitive to changes in transition elements than it was previously. Increased sensitivity is in part due to the loss of intermediate territories characterized by frequent territory abandonment and low probability of colonization in subsequent years. Observed changes in territory use coincide with changes in hydrology and prey availability for Florida Bay. Restoring intermediate territory states to 1960-75 conditions may dampen year to year variability in territory dynamics and serve as a measure of ecosystem restoration at the southern terminus of the Greater Everglades and Florida Bay. Given the reduction in territory utilization and increased frequency of abandonment, management actions should emphasize plans that minimize abandonment and maximize colonization.

BIO: Dr. Bosley is an avian biologist and ecological modeler. Working with Everglades National Park and Florida Atlantic University, his research applies novel modeling techniques to Bald Eagle territory dynamics.

Contact Information: Jason Bosley, 190 NW 31st Ave, Fort Lauderdale, FL 33311, Email: bosleyj@gmail.com

PREDATOR DENSITY AND WATER-LEVEL MEDIATE PREY UTILIZATION OF AN INTERTIDAL ESTUARINE HIGHWAY

Kevin Boswell
Florida International University, Miami, FL, USA

Predator-prey interactions are known to structure critical processes (e.g., trophic transfer, nutrient regeneration) in marine ecosystems and can have important implications for mediating community dynamics. However, the temporal and spatial scales over which these processes operate remain poorly understood and are largely attributed to the lack of resolution offered by traditional sampling techniques. In particular, dynamic coastal systems pose challenges due to the inherent physical complexities associated with persistent environmental fluctuations. Examining the fine-scale temporal and spatial dynamics of predators and prey in tidally-driven estuarine ecosystems requires implementing techniques that are robust to these physically dynamic ecosystems. Here we examine data from a high-resolution multibeam imaging sonar (DIDSON) at the confluence of an intertidal creek channel and a subtidal creek over six complete ebb-flood cycles to quantify the temporal and spatial scales of variance between density estimates of two functional groups (predator vs. prey). Our results showed that densities were strongly associated with tidal stage, irrespective of time of day, and the potential for encounter between predators and prey and utilization of the estuarine intertidal-subtidal complex was mediated by tidal phase. Both predator and prey fishes within the intertidal creek predominately occupied the channel relative to adjacent marsh edge habitats. In addition, our study demonstrates fine-scale asynchronous timing by predators and prey, suggesting that prey dynamics lead predator dynamics in the use of this intertidal creek habitat, i.e., the estuarine highway.

BIO: Kevin Boswell is a marine ecologist, with general interests in the ecology and behavioral dynamics of coastal and marine nekton and surface oriented vertebrates. His research program broadly focuses on the interacting factors that mediate the distributional patterns, behavior, habitat use, energetics and natural ecology of coastal and oceanic animals.

Contact Information: Kevin Boswell, 3000 NE 151st St, North Miami, FL 33478, Email: kevin.boswell@fiu.edu

SNOOK ARE JUST AWESOME WOODSTORKS PT. 2: ASSESSING THE IMPORTANCE OF FORAGING HABITAT AT SPAWNING AGGREGATION SITES FOR TWO ESTUARINE SPECIES

Ross Boucek[1], *Susan Lowerre-Barbieri*[1], *Joel Bickford*[1], *Sarah Walters-Burnsed*[1], *Erin Leon*[2]
[1]Fish Biology, Florida Fish and Wildlife Research Institute, St. Petersburg, FL, USA
[2]Center for biostatistics and modeling, Florida Fish and Wildlife Research Institute, Gainesville, FL, USA

Many species that represent productive marine fisheries form spawning aggregations. Aggregations are predictable both time and space and constitute nearly all of the reproductive activity for these species. Given the importance of spawning aggregation sites, developing conservation strategies aimed at protecting the functions of those locations and the spawning fish there, are crucial to the sustainability of marine fisheries. Similar to migratory birds that require high densities of prey near nesting sites to feed chicks, aggregating fish with protracted spawning seasons may need a productive forage base at or near the spawning site to balance the high energetic cost associated reproduction. Here, we ask how do spawning fish use aggregation sites in relation to where spawning occurs versus adjacent foraging habitats? To answer our research questions, we tracked 30 snook and 29 spotted seatrout at a spawning site during the 2007 spawning season in Tampa Bay (Fl, U.S.) using acoustic telemetry. We quantified space use for both males and females of both species with network analyses. We also calculated the proportion of time per day individuals would spend either at the area where spawning occurs or an adjacent seagrass habitat. Results from network analyses revealed that receivers with the highest edge densities for snook and seatrout occurred within the seagrass habitat. Likewise, we found that both snook and seatrout during the spawning season spent an order of magnitude more time per day within the seagrass habitat adjacent to the spawning site, compared to the spawning site. Our results show that if protected areas are formed based on only where spawning occurs, the reproductive stock will not be protected. Further, our results suggest that spawning areas may have multiple ecological functions (i.e. connectivity to productive forage bases) that may need to be considered in conservation actions.

BIO: Ross Boucek is a fish biologist and a postdoctoral researcher with Florida Fish and Wildlife Research Institute. His research primarily focuses on the role that climate disturbance plays in influencing coastal ecological processes and natural resources.

Contact Information: Ross Boucek, Florida Fish and Wildlife Research Institute, 100 8th Ave Southeast, St. Petersburg, FL 33701, Phone: 727-896-8626, Email: Ross.Boucek@myFWC.com

POTENTIAL TRAJECTORIES OF WATER QUALITY FORCED BY SEA LEVEL RISE IN THE FLORIDA COASTAL EVERGLADES

Henry O. Briceño
Florida International University, Miami, FL, USA

We have investigated the relationships between salinity and nutrients in the mangrove ecotone of the Coastal Everglades and Florida Bay the last 27 years. The objective of this research was to define potential trajectories of water quality change induced by sea level rise. Although models have been developed to determine the required freshwater discharges to reduce salinity during Everglades restoration of Florida Bay, nutrient changes caused by changes of salinity have not been assessed. We present a methodology to assess water quality changes in mangrove forest and coastal embayments of coastal Everglades and Florida Bay, as different regimes are introduced by salinity changes which might be triggered by sea level rise. We use salinity as proxy for sea level rise and nutrient cumulative data calculated along salinity gradients to precisely define break-points and system shifts, combined with sequential t-test analysis of regime-shift to assess the statistical significance of such breaks. Our results indicate that changes in nutrient concentration display complex, non-linear relationships with water discharge, so simple linear regression models may not be adequate to forecast water quality trajectories driven by either sea-level rise and/or restoration.

BIO: Dr. Briceño is a Full Research Professor with more than 12 years of experience in monitoring water quality and water quality restoration in the Everglades and South Florida Coastal and estuarine environments. He has led more than 7 different projects dedicated to preserving and restoring water quality.

Contact Information: Henry O. Briceño, Florida International University, Southeast Environmental Research Center, 11200 SW 8th St, Miami, FL 33199, USA, Phone: 305-348-1269, Email: bricenoh@fiu.edu

TOTAL PHOSPHOROUS LEVELS IN SURFACE WATER DISCHARGES TO SHARK RIVER SLOUGH, EVERGLADES NATIONAL PARK

Henry O. Briceño[1] *Joffre Castro[2] Piero Gardinali[1] and Shishir Sarker[1]*
[1]Florida International University, Miami, FL, USA
[2]National Park Service, Homestead, Florida, USA

Water levels in Everglades marshes and canals are closely tied to management and climate variability. Furthermore, as stages in the Water Conservation Area 3A (WCA-3A) start decreasing, the L67A canal rather than the marsh conveys the majority of the flow into the Everglades National Park (ENP). Canal water is typically of poorer quality than marsh water because canal water has not benefitted from the marsh filtering removal quality of nutrients. Current studies have identified a strong correlation between Total Phosphorous (TP) at S333 (inflow structure to ENP) and canal stage and WCA-3A stage. Low stages are associated with high TP levels at S333. The 12-month flow-weighted mean TP concentration exceeded the Consent Decree limits in water year 2012 and in 2014. The conditions and mechanisms that caused elevated TP in FY2014 (and in previous years) are unknown. Some may result from changes in natural conditions but others may be the direct result of anthropogenic actions. The purpose of this study is to identify the sources of the elevated TP at S333 and, if possible, characterize them as to be from either local effects and conditions at S333 or upstream of S333 within the L67A Canal, L29 Canal or the marsh. Our preliminary conceptual model considers that waters from upstream and along the L67A Canal are mostly the results of managed deliveries by the SFWMD and the exchange with freshwater marshes and groundwater. Also, canal flows, especially at low stage, have the potential of re-suspending and remobilizing nutrient-rich sediments that accumulate at the bottom of canals. These phosphorus-rich sediments can be rapidly transported downstream while contributing part of their P load to canal waters to finally reach the park. Another potential contributing factor to high phosphorus levels is varying environmental conditions such as wet and dry seasons, weather events, and wildfires. Besides stage, preliminary results suggest that, pH, time of the day (insolation?) and turbidity are closely related to water TP concentrations. Furthermore, precisely defined stage level and time of the day thresholds seem to control these physical-chemical and compositional parameters.

BIO: Dr. Briceño is a Full Research Professor with more than 12 years of experience in monitoring water quality and water quality restoration in the Everglades and South Florida Coastal and estuarine environments. He has led more than 7 different projects dedicated to preserving and restoring water quality.

Contact Information: Henry O. Briceño, Florida International University, Southeast Environmental Research Center, 11200 SW 8th St, Miami, FL 33199, USA, Phone: 305-348-1269, Email: bricenoh@fiu.edu

SURVIVAL AND POPULATION GROWTH OF THE AMERICAN CROCODILE (*CROCODYLUS ACUTUS*)

***Venetia Briggs-Gonzalez*[1]**, *Christophe Bonenfant*[2], *Mathieu Basille*[1], *Michael Cherkiss*[3], *Jeff Beauchamp*[1], *Frank Mazzotti*[1]

[1]Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, University of Florida, Ft. Lauderdale, FL, USA

[2]Université de Lyon, Laboratoire de Biométrie et Biologie Évolutive, Lyon, France

[3]U.S. Geological Survey, Wetland and Aquatic Research Center, Center for Collaborative Research, Davie, FL, USA

Successful species conservation is dependent on adequate estimates of population dynamics, but age-specific demographics are generally lacking for long-lived iteroparous species. Accurate demographic information allows estimation of population growth rate, as well as projection of future population sizes and quantitative analyses of fitness trade-offs involved in evolution of life-history strategies. A long-term capture-recapture study was conducted from 1978-2014 on the American crocodile (*Crocodylus acutus*) in southern Florida. Survival was strongly age-dependent with hatchlings having the lowest survival rates but increasing to nearly 90% at adulthood. More than 5% of the female population were found to be reproductive by age 8 years, and the age-specific proportion steadily increased until age 18 when all females were reproductive. Population growth rate estimated from a Leslie-Lefkovich stage-class model showed a positive annual growth rate of 4% over the study period. A sensitivity analysis showed that population growth rate depended strongly on the survival of younger crocodiles until their age of first reproduction, which was similar to the survival of older adults. A comparative approach suggests that large reptiles share life history tactics but one that is unique from similar sized mammals. Crocodiles, as a large, long-lived, highly fecund species deviate from the usual association of life-histories of "slow" species. Current management practices are focused on nests and hatchling survival; however, protection efforts that extend to juvenile crocodiles would be most effective for conservation of the species particularly in an ever-developing landscape.

<u>BIO</u>: Dr. Venetia Briggs-Gonzalez, is a research ecologist with over 15 years of scientific research experience working in south Florida and the Neotropics. Her work focuses on the use of scientific tools and appropriate management to positively impact species and ecosystem function. She has worked with model systems as indicators of change and has been involved in assessing the recovery of at-risk species, such as the American crocodile in the Everglades ecosystem as a result of restoration efforts.

<u>Contact Information</u>: Venetia Briggs-Gonzalez, University of Florida, 3205 College Ave, Davie, FL 33314, USA, Email: vsbriggs@ufl.edu

RECONSTITUTING THE ESTUARINE COMMUNITY OF MAINLAND NEARSHORE SOUTH-CENTRAL BISCAYNE BAY

Joan A. Browder[1], Katarzyna Kulpa[2], Ian Zink, Gladys Liehr[2], Joseph Serafy[1], Diego Lirman[2], Sarah Bellmund[3], Thomas Jackson[1]

[1]NOAA/National Marine Fisheries Service, Miami, FL, USA
[2]University of Miami Rosenstiel School of Marine and Atmospheric Science, Coral Gables, FL, USA
[3]Biscayne National Park, Homestead, FL, USA

One intent of CERP is to restore a more natural pattern of quantity, timing, and distribution of freshwater flow to south-central Biscayne Bay. Restoration of freshwater inflows that respond to rainfall like a natural hydrologic system (i.e., like a system without canals and control structures) is expected to expand the bay area of overlap between favorable salinity patterns and favorable physical features (i.e. shoreline or bottom contours and aquatic vegetation) that provide suitable habitat for the fish, shrimp, and crabs characteristically associated with south Florida estuarine environments. Here we present and build upon our first attempt to describe the epifaunal community that might emerge in Biscayne Bay's western nearshore zone if hydrologic and salinity restoration targets are achieved. We started with our 2007-2011 collections, wet season and dry season, taken by 1m^2 throw-trap (3 throws per site), at 47 sites along the western shoreline between Shoal Point and Turkey Point (RECOVER MAP Epifauna Project). We identified individuals to species and noted the salinity where each individual of a species was captured. A box plot of capture salinities of all individuals of each species revealed the distribution of the species by salinity. We classified species by halohabitat[1] based on this distribution (relying mainly on the 25th percentile and the median). Then we selected species that we classified as belonging to oligohaline, mesohaline, or low polyhaline habitat as species expected to expand spatially and temporally in a restored environment. Another five years of data (2012-2016) became available after the Epifauna project was merged with three other RECOVER MAP Projects into IBBEAM (Integrated Biscayne Bay Ecological Assessment and Monitoring), expanding the ways that the data could be examined. For example, we could compare species in each halohabitat category between (1) the two periods, (2) the two seasons, (3) wet and dry moderate years, and (4) wet and dry year extremes. Such analyses will help us test the hypothesis that change in species composition toward species associated with mesohaline habitat would accompany hydrologic and salinity restoration. Because the period and area covered by our monitoring may be too limited at the lower end of the salinity range, we are using past fishery data and contemporary studies in our region to build a larger list of likely colonizers to populate mesohaline habitat in the Bay's nearshore zone if ecologically controlling pre-drainage characteristics of freshwater inflow and salinity regime are reinstated. We expect to demonstrate that communities of species classified by their halohabitat can be followed over time to determine their direction and degree of change. Watching these communities change over space and time as the hydrologic restoration effort proceeds will help us to learn the characteristics of freshwater inflow and salinity that will best support the target community and to determine whether the restoration effort is progressing sufficiently and in the right direction.

[1]Halohabitat is our modification of the Venice system for classifying water bodies by salinity.

Contact information: Joan A. Browder, NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL, USA 33149, Phone: 305-361-4270, Email: joan.browder@noaa.gov.

USE OF A NATURAL SYSTEM REGIONAL SIMULATION MODEL IN RESTORATION PROJECT PLANNING

Winifred P. Said[1], ***M. Clay Brown***[2]

[1]Consultant, Jupiter, FL, USA

[2]South Florida Water Management District, West Palm Beach, FL, USA

Restoration project planning requires an understanding of the regional system hydrology prior to drainage and development. Natural system modeling has been used, in combination with other adaptive management tools, for restoration plan formulation.

The Natural System Regional Simulation Model (NSRSM) is one of the modeling tools that are currently being implemented by the South Florida Water Management District (SFWMD) to provide insight in evaluating restoration alternatives. The numerical code behind the NSRSM is the hydrologic simulation engine (HSE). The HSE engine of the Regional Simulation Model (RSM), developed over the last decade by the SFWMD, integrates 2-D overland flow, 3-D ground water flow, 1-D channel flow, and lake inflow/outflow within the greater Kissimmee-Lake Okeechobee-Everglades watershed from Lake Kissimmee south to Florida Bay. The NSRSM's use of long-term climatic data and refined parameter input (e.g. circa mid 1800's topography, landcover, and river network) in combination with technological advancements within the model's hydrologic simulation engine (HSE), have resulted in simulations that reasonably represent pre-drainage hydrology in south Florida. Recent uses of the NSRSM include the RECOVER evaluation, River of Grass, and the Western Everglades Restoration Project.

<u>BIO</u>: Clay is a water resources engineer with more than 15 years of modeling experience in south Florida hydrology. He also has extensive experience with natural systems models, programming, and GIS.

<u>Contact Information</u>: M. Clay Brown, Section Lead, Hydrology and Hydraulics Bureau, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406 USA, Phone: 561-682-2256, Email: mcbrown@sfwmd.gov

SPATIO-TEMPORAL NICHE DIFFERENTIATION FOR SEA TURTLES TRACKED IN AND AROUND DRY TORTUGAS NATIONAL PARK, FL

***David Bucklin*[1]**, *Mathieu Basille*[1], *and Kristen Hart*[2]
[1] Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, University of Florida, Davie, FL, USA
[2] Southeast Ecological Science Center, U.S. Geological Survey, Davie, FL, USA

Five species of marine sea turtles nest and forage along Florida's coastline, all of which are listed as threatened or endangered by the Endangered Species Act. In Dry Tortugas National Park, encompassing the westernmost islands of the Florida Keys, Loggerhead (*Caretta caretta)* and Green (*Chelonia mydas*) sea turtles are the most common, frequently nesting on sandy beaches of the seven small islands in the park. Hawksbills (*Eretmochelys imbricata*) can also be found in park waters. Being an important nesting and foraging area for populations of multiple species of sea turtles, it is critical to understand the specific characteristics that distinguish species' usage of the area, in order to inform conservation management at the species level, especially given the Dry Tortugas' location within a larger marine protected area (the Florida Keys National Marine Sanctuary).

We compiled a database of captures and satellite tracking data from tags deployed on 113 individual sea turtles captured in Dry Tortugas (including Loggerheads, Greens, Hawksbills, and Loggerhead/Hawksbill hybrids). Over a 9-year period (2008-2016), we extracted data from 152 turtle-years, with an average timespan of 72 days, which corresponded to an average of 78 reliable locations in the study area per turtle-year. We derived a set of spatio-temporal variables summarizing each turtle's movements during the turtle-year, and used linear discriminant analyses (LDA) to analyze differences along these spatio-temporal variables among species, and between sexes and age classes.

Discriminant analyses indicated a clear spatio-temporal differentiation between Loggerhead and Green sea turtles in and around Dry Tortugas National Park, primarily due to spatial and environmental factors such as location of the home range, seafloor depth, and seabed sediment composition. Despite low sample sizes, we did note a distinct niche for Hawksbills, but no discrimination between Loggerheads and the Loggerhead/Hawksbill hybrids. Females, males, and juveniles had large niche overlap when analyzed independent of species, but when analyzed by species-sex groups, Loggerhead females were distinct from all other groups. Further analyses will focus on within-year differences and spatio-temporal differentiation between nesting females, to further disentangle critical components of sea turtle conservation.

BIO: David Bucklin is a biological scientist in Dr. Mathieu Basille's Landscape Ecology lab at the Fort Lauderdale Research and Education Center. He manages databases storing animal capture and movement datasets for species of conservation concern across Florida, and works on tools to store, manage, and analyze these datasets.

Contact Information: David Bucklin, 3205 College Avenue, Fort Lauderdale, FL, USA 33314, Email: dbucklin@ufl.edu

EFFECTS OF HYDROSCAPE MODIFICATION ON EVERGLADES AQUATIC CONSUMERS: EVALUATING TWO HYPOTHESES

***Michael Bush**, John Gatto, Alex Onktos, and Joel Trexler*
Florida International University, Miami, FL, USA

We used experimental manipulation of water flow from the DECOMP Physical Model (DPM) to evaluate proposed benefits of re-connecting regions of the Everglades and re-creating historical velocities of sheet flow. We examined two hypotheses related to the effects of sheet flow on aquatic consumers: (H1) historical flows were too low to have direct effects on fish movement and distribution; and (H2) removal of levees and filling of a deep-water canal change habitat connectivity and affect consumer movements linked to recovery from drought.

We conducted laboratory swimming performance analysis of six common small-bodied Everglades fishes (Eastern Mosquitofish, Golden Topminnow, Flagfish, Sailfin Molly, Bluefin Killifish, and Least Killifish) to evaluate the direct effect of Everglades flow velocities on swimming performance using standard metrics such as critical swimming speed (H1). We found that flow velocities at or below the highest ones created in the DPM flow path exceed the maximum flows in which small juveniles of Least Killifish and Bluefin Killifish can maintain their position, but were below critical velocities for adults of all species tested.

We used a before-after-control-impact (BACI) study to evaluate H2 with field sampling by throw traps, drift fences, and airboat-mounted electrofishing. Community structures of several sites changed after alterations from DPM, but communities on either side of the degraded levee failed to become more similar after they were hydrologically connected. Differences between impact and control marsh-fish density increased over three-fold after a stretch of canal was filled to marsh level. There were also species-specific differences in movement behavior before and after hydroscape alteration. Golden Topminnows exhibited little directional movement towards or away from the canal prior to alteration, but displayed strong directed movement away from the canal as marsh water levels rose after the alteration occurred. Large fish CPUE from the canal-fill area increased compared to marsh transects. Fishes that depend on excavated nest building, such as Largemouth Bass and sunfishes, responded positively to canal filling.

Radio-tracking of Largemouth Bass and Bowfin revealed little difference in weekly movement rates before and after hydroscape modification, but both species made long-distance movements across the filled canal and through the degraded levee. Eleven of 80 tagged fish (14%) moved through the degraded levee during 2013 and 2014. Of those moving, 6 (54%) did so during the experimental flow periods. Prior to 2013, no fish were recorded moving through the northern degraded levee and into WCA 3B. Levee removal and canal filling changed small and large fish movement patterns and increased connectivity. Canal filling created habitat that attracted fishes and was used by recreational species like Largemouth Bass.

BIO: Michael Bush is a graduate student with the Department of Biological Sciences at Florida International University. This work was conducted as part of the requirements for a Ph.D. degree.

Contact Information: Michael Bush, 3001 40th Ave S, Unit G, Fargo, ND 58104, Phone: 763-232-9635, Email: MikeRBush@gmail.com

PREDICTING THE RESPONSES OF SEAGRASS AND OYSTER HABITATS TO CHANGES IN WATER MANAGEMENT

Christopher Buzzelli *and Peter Doering*
South Florida Water Management District, West Palm Beach, FL, USA

Benthic habitats such as seagrass meadows and oyster reefs have tremendous ecological and economic value in the coastal zone. These habitats trap sediments and stabilize shorelines, filter the overlying water, and provide food and refuge for a variety of fauna. Habitat composition, distribution, and density are modulated by environmental factors such as salinity, temperature, freshwater and nutrient inputs, and local water quality. The ecological benefits of seagrass and oyster habitats and their relative sensitivity to different factors makes them effective indicators of environmental conditions.

Seagrass and oyster habitats are valued ecosystem components (VEC's) in the south Florida coastal zone. The status and survival of these habitats can be indicative of conditions in the Indian River Lagoon (IRL), the St. Lucie Estuary (SLE), the Loxahatchee Estuary (LE) and Lake Worth Lagoon (LWL) on the east coast and the Caloosahatchee River Estuary (CRE), Naples Bay (NB), and Estero Bay (EB) on the west coast. Each of these water bodies is influenced by managed freshwater inflow which can affect both salinity and water quality. Moreover, the external inputs to and the internal ecological responses within south Florida estuaries fluctuate on seasonal, inter-annual, and climatic (3-5 y) time scales. Thus, the ability to predict the potential responses of seagrasses and oysters to different inflow and salinity patterns over a range of scales is essential for water and coastal resource management.

Ecological modeling offers a quantitative framework to integrate various types of data, identify missing information, and generate possible ecological outcomes for alternative environmental scenarios. Seagrass models were developed for the southern IRL (manatee grass or *Syringodium filiforme*) and the lower CRE (shoal grass or *Halodule wrightii*). These simple ecological models were created to assess relationships between freshwater inflow, salinity, and water clarity. Similarly, an oyster model was used to examine physical flushing, phytoplankton growth, and oyster filtration capacity in the SLE. While these base models targeted ecological dynamics on monthly-annual time scales, they are easily refined to predict potential changes in plant and animal densities with the implementation of long-term water management projects. For example, seagrass-oyster-salinity (SOS) models were customized for application to the Central Everglades Planning Project (CEPP). The ultimate power of ecological simulation models is as an integrative research tool to help build consensus among scientists, managers, and stakeholders.

BIO: Dr. Buzzelli is a Lead Scientist with more than 20 years researching coastal ecosystems in Virginia, North Carolina, South Carolina, and south Florida. He specializes in the study of estuarine ecology including the impacts of sea level rise, hurricanes, and eutrophication and has authored and co-authored more than 30 publications.

Contact Information: Christopher Buzzelli, Coastal Ecosystems Section, South Florida Water Management District, 3301 Gun Club Rd., West Palm Beach, FL, USA 33406 , Phone: 561-682-6519, Email: cbuzzell@sfwmd.gov

DECADAL VARIATIONS OF MERCURY IN MOSQUITO FISH IN THE EVERGLADES AND RELATION TO CHANGES IN ATMOSPHERIC HG DEPOSITION AND ECOSYSTEM ALTERATION

Yong Cai,[1,2] *Yanbin Li,*[3] *Guangliang Liu,*[1,2] *Jennifer Richards,*[4] *Leonard J. Scinto,*[5] *Peter Kalla*[6], *Daniel Scheidt*[7]

[1]Department of Chemistry & Biochemistry, Florida International University, Miami, FL, USA
[2]Southeast Environmental Research Center, Florida International University, Miami, FL, USA
[3]Key Laboratory of Marine Chemistry Theory and Technology, Ocean University of China, Qingdao, China
[4]Department of Biological Sciences, Florida International University, Miami, FL, USA
[5]Department of Earth and Environment, Florida International University, Miami, FL, USA
[6]U.S. Environmental Protection Agency, Region 4, Science and Ecosystem Support Division, Athens, GA, USA
[7]U.S. Environmental Protection Agency, Region 4, Water Management Division, Athens, GA, USA

Mercury (Hg) pollution is recognized as one of the major water quality concerns in the Florida Everglades. However, there is a lack of knowledge on the long-term variation in fish Hg in this ecosystem and its controlling factors. The changes in Hg atmospheric deposition and the alteration in ecosystem characteristics are two important factors controlling the temporal variations in fish Hg. The ecosystem of the Everglades has been altered since the inception of the Comprehensive Everglades Restoration Plan (CERP) in 2000. In this study, the variation in mosquitofish Hg in the past two decades was studied using the EPA REMAP data from 1995-2014. A substantial decline in mosquitofish Hg was observed from 1995 to 2014. The decreasing rate in dry season (~7%/a) was higher than that in wet season (~4%/a). Similar decrease in mosquitofish Hg was observed at all four areas (WCA 1, WCA 2, WCA 3 and ENP) of the Everglades. Negligible change was observed for the wet deposition of Hg in the Everglades by analyzing the Mercury Deposition Network (MDN) data from 1996 to 2015, suggesting that the deposition of Hg into the Everglades is stable in the past twenty years. This finding was supported by the minor changes in water and sediment THg from 1995 to 2014. Therefore, the decrease in mosquitofish Hg does not seems to be caused by the change in atmospheric deposition of Hg in the Everglades. MeHg is mainly produced in sediments and periphyton in the Everglades. No significant change in MeHg was detected in the sediment of the Everglades; however, MeHg in the water and periphyton decreased dramatically during this period, especially in the dry season (dry season: 7%/a (periphyton) and 4%/a (water); wet season: 1%/a (periphyton) and 3%/a (water)). The decrease in periphyton and water MeHg could explain, to some extent, the decrease in mosquitofish Hg in consideration of Hg bioaccumulation from water and periphyton to mosquitofish. Phosphorus and sulfate in water showed a significant decreasing trend in the Everglades in the past twenty years, attributed to the implementation of the CERP project. Phosphorus is expected to significantly affect the biomass and composition of periphyton while sulfate is one of the necessary reactants for Hg methylation. The decrease in both substances in Everglades water may inhibit the production of MeHg by periphyton, subsequently causing the decrease in mosquitofish Hg.

<u>BIO</u>: Dr. Yong Cai is a Professor in the Department of Chemistry & Biochemistry and Southeast Environmental Research Center at Florida International University. He has been conducting research in the broad field of chemistry and environmental science, focusing on speciation analysis, fate, and transport of toxic metals and metalloids in the environment and biological systems and their environmental and public health impact.

<u>Contact Information</u>: Yong Cai, Department of Chemistry & Biochemistry, Florida International University, Miami, FL 33199, Phone: 305-348-6210, Fax: 305-348-3772, Email: cai@fiu.edu

PHYSICAL, CHEMICAL, AND BIOLOGICAL PROCESSES CAUSE SEAGRASS MORTALITY IN FLORIDA BAY

Paul R. Carlson[1], *Laura A. Yarbro*[1], *Vicki McGee-Absten*[2], *Daniel Carlson*[3], *Sheila Scolaro*[1], *and Michael Poniatowski*[1]

[1]Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL, USA
[2]Florida International University, Miami, FL, USA
[3]University of Aarhus, Aarhus, DK

Catastrophic mortality of seagrass in Florida Bay from 1987 to 1991 resulted in the complete loss of thousands of hectares of dense *Thalassia testudinum* beds (1). In that event, acutely toxic levels of dissolved sulfide in sediments (2) and sulfide intrusion (3) were determined to be the proximal causes of seagrass mortality, but the mechanisms responsible for sulfide accumulation in sediments were not demonstrated. Hypersaline conditions in Florida Bay occurred at the same time and were implicated as distal causes for the massive seagrass die-off event (4). Subsequent field and mesocosm studies therefore focused on the synergistic effects of elevated sediment sulfide and hypersalinity (5) as well as potential pathogens such as the protist *Labyrinthula*, but none of those studies were able to duplicate the rapid and extensive mortality of *Thalassia* observed in Florida Bay between 1987 and 1991.

With the recurrence of seagrass mortality in Florida Bay in summer 2015, however, we validated the conceptual model of die-off proposed by Carlson et al. (6) and we documented the interaction of several physical, chemical, and biological processes that cause catastrophic mortality of *Thalassia*. Regional drought and elevated water temperature lead to hypersalinity, particularly in north-central Florida Bay. In addition, evaporation of seawater on mudbanks creates stable benthic "brine" layers in seagrass beds. These benthic boundary layers, in turn, limit oxygen diffusion and prevent oxidation of sulfide in sediments and bottom water, exposing roots, rhizomes, and lateral meristems of *Thalassia* to acutely toxic levels of sulfide, causing rapid and extensive mortality. Dead belowground tissues provide labile organic matter to sulfate-reducing bacteria enhancing sulfide production and creating a positive feedback loop of increasing sulfide toxicity leading to additional seagrass death. Sediment sulfide levels decline to sublethal levels when water temperatures, sediment organic matter, and salinities drop, effectively resetting the system. In the future, increased delivery and/or diversion of fresh water during droughts might prevent seagrass die-off events in Florida Bay or reduce their impacts.

References Cited:

(1) Robblee, M. B., T. R. Barber, P. R. Carlson, M. J. Durako, W. Fourqurean, L. K. Muehlstein, D. Porter, L. A. Yarbro, R. T. Zieman, and J. C. Zieman. 1991. Mar. Ecol. Progr. Ser. 71: 297-299.
(2) Carlson, P. R., L. A. Yarbro, and T. R. Barber. 1994. Bull. Mar. Sci. 54: 733-746.
(3) Borum, J., O. Pedersen, T. M. Greve, T. A. Frankovich, J. C. Zieman, J. W. Fourqurean, and C. J. Madden. 2005. J. Ecol. 93: 148-158.
(4) Zieman, J. C., J. W. Fourqurean, and T. A. Frankovich. 1999. Estuaries 22: 460-470.
(5) Koch, M. S., S. A. Schopmeyer, O. I. Nielsen, C. Kyhn-Hansen, and C. J. Madden. 2007. J. Exp. Mar. Biol. Ecol. 350: 73-88.
(6) Carlson, P. R., L. Yarbro, and T. R. Barber. 2000. Proc. 1999 Florida Bay Adj. Marine Systems Science Conf., pp. 10-11.

BIO: Dr. Carlson has served as a research scientist with FWRI for 33 years and was one of the team members that investigated the 1987-1991 seagrass die-off event in Florida Bay. Currently, he is co-PI of the Florida Seagrass Integrated Mapping and Monitoring (SIMM) program led by Dr. Laura Yarbro.

Contact information: Paul Carlson, FL Fish and Wildlife Conservation Commission, 100 Eighth Ave SE, St. Petersburg, FL, 33701, Phone: 727-243-7251. Email: paul.carlson@myfwc.com

RESTORATION OF A VALUED ECOSYSTEM COMPONENT, *VALLISNERIA AMERICANA* IN THE CALOOSAHATCHEE RIVER & ESTUARY

***David W. Ceilley*[1]*,* *Edwin M. Everham*[2]*, III, Carter E Henne*[3]*, and James F. Anderson*[3]
[1]Johnson Engineering Inc. Ft Myers, FL, USA
[2]Florida Gulf Coast University (FGCU), Ft Myers, FL, USA
[3]Sea and Shoreline LLC, Ruskin, FL, USA

Historic water management practices, prolonged drought, high salinities, and the loss of sediment seed bank have all contributed to the loss of over 2,000 acres of submerged aquatic vegetation, specifically *Vallisneria americana* (tape grass, eel grass, wild celery) in the Caloosahatchee River upper estuary. *V. americana* was identified as a Valued Ecosystem Component (VEC) for establishing minimum flows and levels (MFL) in the Caloosahatchee in 2001. The loss of oligohaline grass beds had cascading negative impacts on the entire ecosystem. Early restoration efforts in 2002-03 found that herbivory was the regulating factor preventing *V. americana* beds from recovering in the tidal portions of the Caloosahatchee. Subsequent studies found that excessive herbivory is also controlling regrowth and in the freshwater Caloosahatchee River also. Known grazers include native turtles, waterfowl, decapod crustaceans, West Indian manatees, and more recently the non-native apple snails (*Pomacea maculata*). Grazers are limiting the growth and maturation of *V. americana* plants and thus prevent flower production. Current *V. americana* restoration involves using small, circular, wire mesh exclosures planted with male and female *V. americana* to assess flower production, growth rates and expansion outside exclosures. The C-43 reservoir construction is currently underway to help maintain minimum flows and levels for the Caloosahatchee. Restoration of the Caloosahatchee estuary will require restoration of thousands of acres of *V. americana* beds in both the freshwater and tidal sections. A current public-private partnership proposes a large-scale *V. americana* restoration project to the Gulf of Mexico Benefit program and RESTORE Act.

BIO: David W. Ceilley is a certified senior ecologist at Johnson Eng. and a graduate faculty member at FGCU with 30 years of professional experience. Specializing in freshwater ecosystems, he designed and implemented baseline aquatic fauna assessments for the Picayune Strand Restoration Project and Babcock Ranch Preserve.

Contact Information: David W. Ceilley, Senior Ecologist, Johnson Engineering Inc., 2122 Johnson Street, Ft. Myers, FL, USA 33901, Phone: (239) 461-3395, Fax: (239) 334-3661, Email: dceilley@johnsoneng.com

RESTORATION BENEFITS OBSERVED FROM THE BISCAYNE BAY COASTAL WETLANDS PROJECT

Bahram Charkhian
South Florida Water Management District, West Palm Beach, FL, USA

The purpose of the Biscayne Bay Coastal Wetlands (BBCW) project is to contribute to the restoration of Biscayne Bay and adjacent coastal wetlands as part of a comprehensive plan for restoring the south Florida ecosystem. The project redistributes freshwater from existing point source canal discharges to coastal wetlands adjacent to Biscayne Bay providing for a more natural and historic overland flow to remnant tidal creeks. The project will improve the ecological function of saltwater wetlands and the nearshore bay environment by improving salinity conditions for fish and shellfish nursery habitat.

The Water Resources Reform and Development Act of 2014 authorized the Biscayne Bay Coastal Wetlands Project. Elements of these projects have been constructed and operated over the last 5 years.
BBCW Phase 1 is composed of three components: Deering Estate, Cutler Wetlands and L-31E Flow Way. In advance of congressional authorization, the South Florida Water Management District (SFWMD) constructed the Deering Estate Flow Way and installed culverts for the L-31E Flow Way. By expediting the completion of these project features, hydrologic improvements and environmental benefits are already being realized.

Comparison of ecological monitoring data collected during the last five years with previous baseline data, indicates that the project is trending towards success. There is improved water quality to the bay as fresh water is redirected from canals to wetlands via the L-31E Culverts and the Deering Estate Flow-way. Additionally, point source fresh water discharges have been reduced. Monitoring results clearly demonstrate improved hydrologic conditions in response to operation of the Deering Estate pump station (S-700). The BBCW L-31E Interim electric pump was installed in March 2016, and will become operational in November 2016.

Vegetation within the vicinity of Deering Estate Flow-way is responding to improved hydrology demonstrated by die-off of upland vegetation, emergence of wetland species and expansion of sawgrass. Surface water salinity decreased to <1 in response to the pumping of fresh water from the Deering Estate Flow-way Pump Station into the historic remnant wetlands in the vicinity of Cutler Creek. Groundwater salinity near the Deering Estate Flow-way also responded to the input of fresh water from S-700 into the historic remnant wetlands, salinity decreased to less than 10. Sawgrass mapping of 470 acres in the Miami Dade-County Preserve wetlands was performed in 2013 and 2016. During that period of time there was a 48 acre increase. During both semi-annual monitoring events in 2016 an increase in periphyton, various bird species, amphibians, invertebrates, and fish were observed. During this same period there was a decrease in invasive exotic plants species as well.

This presentation will focus on recent restoration benefits in the Biscayne Bay Coastal Wetland Project.

<u>BIO</u>: My name is Bahram Charkhian, I am lead environmental scientist with South Florida Water Management District. I have been with SFWMD for 18 years and I am ecological and site manager for the Biscayne Bay Coastal Wetlands Project. Responsible for all PIR and compliance monitoring activities, assessing performance of the project, and making recommendation to enhance and improve performance of this project. I am also assisting CERP RECOVER Program manager with activities related to this project too.

<u>Contact Information</u>: Bahram Charkhian, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406 USA, Phone: 561-682-2284, Email: Bcharkh@sfwmd.gov

LANDSCAPE-LEVEL CORRELATES OF WADING BIRD STRESS IN A SEASONALLY FLUCTUATING, SUBTROPICAL LAKE

Jennifer E. Chastant[1] *and Dale E. Gawlik*[2]
[1]Palm Beach County Department of Environmental Resources Management, West Palm Beach, FL, USA
[2]Florida Atlantic University, Boca Raton, FL, USA

Hormones play an essential role in governing an animal's response to environmental variation in food availability. Studying the stress response can therefore provide inference about environmental conditions that may regulate a population's survival and reproduction. We measured the stress response to hydrologically-mediated changes in food availability using the cellular chaperone stress protein 60, fecal corticosterone, and yolk corticosterone (YCORT) in the eggs and nestlings of Great (*Ardea alba*) and Snowy Egrets (*Egretta thula*) at Lake Okeechobee, a highly managed reservoir in Florida. We also provided supplementary food to free-living Snowy Egret nestlings during two years with different hydrologic conditions and food availability to test for hormonal responses to food limitation. We found no effect of food supplementation on hormonal response, suggesting that wading birds nesting at the lake are not food limited, or the particular hormones we measured are not sensitive to the level of food limitation the birds experienced. The amount of available foraging habitat had the greatest effect on the stress response of Great Egret nestlings, whereas amount of foraging habitat and prey density both influenced the stress response of Snowy Egret nestlings. Temperature and foraging conditions influenced YCORT concentrations for both egret species. Our results support the hypothesis that hydrologic factors associated with prey availability play an important role in regulating wading bird nesting patterns, although the level of food limitation the birds experience may not be as severe as expected. Results also demonstrated that the Snowy Egret stress response was more sensitive to changes in prey availability than the Great Egret stress response.

BIO: Dr. Chastant is an Environmentalist with over 7 years of experience in south Florida wetland ecosystems and more than 15 years of experience studying and restoring freshwater ecosystems throughout North America.

Contact Information: Jennifer Chastant, Palm Beach County Department of Environmental Resources Management, 2300 N. Jog Road, 4th Floor, West Palm Beach, FL 33411, Phone: 561-233-2563, Email: JChastant@pbcgov.org

PRESERVING THE SOUTH FLORIDA ECOSYSTEM MOSAIC: PALM BEACH COUNTY NATURAL AREAS WITH EMPHASIS ON ACREAGE PINES NATURAL AREA

Jennifer E. Chastant
Palm Beach County Department of Environmental Resources Management, West Palm Beach, FL, USA

In the early 1980s, concerns over rapid urbanization in Palm Beach County (County) lead 14 environmental groups to form the Coalition for Wilderness Islands (the Coalition). In May 1984, the Coalition proposed a program to the Board of County Commissioners (the Board) for the establishment of "wilderness islands" to preserve examples of the best remaining native ecosystems in the County. The Board supported this recommendation and an inventory of native ecosystems in Palm Beach County, was conducted in 1987 and 1988. The inventory identified 38 eco-sites as suitable for acquisition. The size of eco-sites ranged from two or three acres for some rare upland ecosystems to over 15,000 acres for a wetland/upland mosaic site. Using state and local funds, the County has acquired and preserved over 31,000 acres of land as natural areas. The natural areas are open for passive recreational activities such as hiking, bird watching, nature study, photography, environmental education and scientific research. Many natural areas have public use facilities including accessible nature trails, hiking trails, wildlife observation platforms and/or shade shelters, parking areas, bike racks, and informational kiosks.

Acreage Pines Natural Area is located in an unincorporated portion of west-central Palm Beach County. This 124-acre natural area was purchased by the County in 2001 with the primary goal of preserving important remnants of the greater Loxahatchee Slough eco-site. Restoration efforts have focused on removing invasive nonnative vegetation, introducing prescribed burns, and restoring hydrology to historic wetland levels. Site restoration and enhancement projects to date include the mechanical removal of 18-acres of melalueca (*Melaleuca quinquenervia*) monoculture, herbicide treatment of torpedo grass (*Panicum repens*) and Old World climbing fern (*Lygodium microphyllum*), construction of water-control structures to retain water on site, and off-road vehicle traffic prevention. Photo monitoring stations and vegetation transects were established to document the elimination of exotic vegetation as well as the recovery and re-growth of native vegetation. Following the mechanical removal of melalueca, the percent coverage of native vegetation in the depressional wetlands almost doubled and the percent coverage in the hydric pine ecosystem nearly tripled in the first year. By the third year of the study, the project success criteria of >80% native vegetation coverage had been met and <1% of the vegetation observed within the quadrats was nonnative. The County takes an aggressive approach to invasive nonnative vegetation removal and the success documented at Acreage Pines Natural Area is just one example of the County's many restoration achievements.

BIO: Dr. Chastant is an Environmentalist with over 7 years of experience in south Florida wetland ecosystems and more than 15 years of experience studying and restoring freshwater ecosystems throughout North America.

Contact Information: Jennifer Chastant, Palm Beach County Department of Environmental Resources Management, 2300 N. Jog Road, 4th Floor, West Palm Beach, FL 33411, Phone: 561-233-2563, Email: JChastant@pbcgov.org

SEA TURTLE NESTING IN EVERGLADES NATIONAL PARK: INTEGRATING BEACH SURVEYS, SATELLITE TRACKING, AND GENETICS

Andrew G. Crowder[1], *Kristen M. Hart*[2] *and* ***Michael S. Cherkiss***[2]
[1]Cherokee Nations Technologies, Contracted to the U.S. Geological Survey, Davie, FL, USA
[2]Wetland and Aquatic Research Center, U.S. Geological Survey, Davie, FL, USA

Despite state-wide monitoring efforts on mainland Florida beaches to map and enumerate nesting effort for loggerhead sea turtles (*Caretta caretta*), very little focus has been on sampling sea turtles on nesting beaches in Everglades National Park (ENP). These remote sandy beaches of the ENP are comprised of 18 individual beaches that cover a total length of 56,650 m. Intense surveys of these beaches in the 1970s and 1980s indicated that these beaches are used by federally-threatened loggerhead sea turtles for nesting. Recent genetic analyses of loggerheads in the U.S. Atlantic have distinguished four subpopulations in the region. However, it is currently unclear to which subpopulation loggerheads nesting in the Everglades belong, as they have not been included in these analyses. Through our on-the-ground effort complemented by the National Park Service (NPS) aerial surveys (from a fixed-wing aircraft) intended to document sea turtle nests and false crawls on all sandy remote beaches of the Everglades we are addressing these questions. In addition, there is a paucity of information on the impacts of sea level rise on nest success rates of the historically important Cape Sable sea turtle rookery, once thought to be among the largest remaining rookeries for the loggerheads, and one that may be least-impacted by humans and development.

In May 2014 we initiated a tagging and tracking program, using genetic tools to determine stock structure for this rookery and satellite-tracking technology to characterize movements and quantify home ranges of individuals. Thus far we have collected genetic samples and deployed satellite tags on 7 nesting loggerheads; none of these had any tags from other research projects. Analysis of 3/7 genetic samples revealed the presence of the A 2.1 haplotype; analysis of the remaining samples is underway.
In recent years, satellite-telemetry studies have dramatically increased our understanding of spatial habitat-use patterns of the complex life history of marine turtles, including nesting behavior. Much focus has been on tracking females post-nesting to determine regional linkages between nesting beaches and foraging grounds, as well as zones of overlap with fishing activities. By outfitting nesting loggerheads in the Everglades with satellite-tags, we delineated the spatial extent of loggerhead habitat-use areas during the critical inter-nesting period. We also tracked turtles post-nesting to other locations in the region where they took up residence at foraging sites; locations were in waters of the Everglades National Park, Florida Keys National Marine Sanctuary, Florida Bay, Gulf of Mexico, the southern Bahamas, and off the northeastern coast of Cuba. These data will allow us to define movement corridors and foraging habitat, providing a new understanding of regional connectivity of disparate sites that are important for this threatened species.

BIO: Michael Cherkiss is a wildlife biologist with more than 20 years' experience working in the Everglades. He has extensive experience with large reptiles, invasive species and restoration ecology.

Contact Information: Michael Cherkiss, U.S. Geological Survey, 3321 College Ave, Davie, FL, 33314, Phone:954-377-5935, Email:mcherkiss@usgs.gov

PERIOD-OF-RECORD PHOSPHORUS RETENTION IN THE EVERGLADES STORMWATER TREATMENT AREAS – 1994 TO 2016

Michael J. Chimney *and Shi Kui Xue*
South Florida Water Management District, West Palm Beach, FL, USA

The South Florida Water Management District (District) operates five large freshwater treatment wetlands south of Lake Okeechobee, referred to as the Everglades Stormwater Treatment Areas (STAs), as part of the agency's Everglades restoration efforts. The purpose of the STAs is to reduce total phosphorus (TP) concentrations in stormwater runoff coming primarily from the Everglades Agricultural Area before this water is released south to the Everglades Protection Area (EPA). The STAs are operated as passive, once-through treatment systems. Stormwater runoff is routed to the STAs through a system of canals, pump stations and other water control structures that are part of the District's flood control infrastructure. The STAs reduce TP concentrations in runoff through a combination of biological, chemical and physical mechanisms with the primary mechanism being P uptake from the water column by algae, microbes and plants and the eventual accretion of this biomass into the wetland sediments. The first STA (STA-1 West) had a wetted surface area of 1,544 ha (3,815 ac) and began operation in 1994. Design and construction of the other STAs (STA-1 East, STA-2, STA-3/4, STA-5 and STA-6) was initiated from 1994 to 1996 and these systems began flow-through operation at staggered intervals from 1997 through 2004. The STAs currently have a combined treatment area of 22,755 ha (56,230 ac), a fifteen-fold increase in size since 1994. This poster summarizes aspects of TP treatment performance in the STAs over their cumulative 22-year period-of-record (POR).

The total volume of water treated annually in the STAs has been roughly proportional to the increase in STA surface area as new STAs came online ($R^2 = 0.71$). Over their POR, the STAs collectively have treated 2.15×10^{10} m^3 (17.4M ac-ft) of runoff and retained 2,220 metric tons (t) of P that otherwise would have entered the EPA. While only 32% of annual flow-weighted mean (FWM) outflow TP concentrations for individual STAs have been equal to or less than 19 µg P L^{-1} (one of the target outflow TP concentrations mandated by the new STA operating permit), the annual FMW outflow TP concentration averaged across all the STAs has ranged from 17 to 21 µg L^{-1} in the past six water years. Concern has been voiced that the STAs would become saturated with P over time and lose their ability to treat runoff. However, inspection of cumulative inflow TP versus cumulative TP retained double mass curves for each STA and the STAs combined did not reveal any long-term decline in treatment performance. On the contrary, the cumulative percent TP mass retained in each STA and all the STAs combined has been relatively constant or increased slightly in recent years. The POR percent TP mass retained in individual STAs has ranged from 69 to 85% and is 76% for all STAs combined. On a long-term basis, STA treatment performance is moderately to strongly correlated with how individual STAs were loaded. For example, the POR unit-area TP mass retained (g m^{-2}) and the POR FWM outflow TP concentration (µg P L^{-1}) for individual STAs and the STAs combined were largely a function of the POR unit-area TP inflow load (g m^{-2}) and the POR FMW inflow TP concentration (µg P L^{-1}), respectively (R^2 = 0.97 and 0. 90), while the average annual TP loading rate for individual STAs and the STAs combined (g m^{-2} yr^{-1}) accounts for more than 50% of the variability in the POR FWM outflow TP concentration (µg P L^{-1}) ($R^2 = 0.65$).

BIO: Dr. Chimney is an applied limnologist with 35 years of research and monitoring experience in a variety of freshwater habitats. He holds professional certifications from SWS, ESA and NALMS. Employed at the District since 1993, Dr. Chimney has participated in numerous projects involving the STAs and other water treatment technologies.

Contact Information: Dr. Michael J. Chimney, South Florida Water Management District, 3301 Gun Club Rd., West Palm Beach, FL, USA 33406, Phone: 561-682-6523, Email: mchimney@sfwmd.gov

MODELING RESTORATION OUTCOMES FOR THE EVERGLADES RIDGE-SLOUGH LANDSCAPE

Jay Choi *and Jud Harvey*
U.S. Geological Survey, Reston, VA, USA

The predrainage Everglades had well-connected deep-water sloughs interspersed between linear sawgrass ridges. The sloughs supported high aquatic productivity, maintained pathways for animal dispersal, and provided edges for feeding and nursery habitats that helped support a diverse assemblage of fish and wildlife. At present only 18% of the predrainage ridge and slough landscape remains in a high-functioning state. Over-drainage decreased water levels and slowed the flow, which permitted peat oxidation and prevented natural processes of sediment redistribution from sloughs to ridges. Microtopographic variation that is essential to co-existence of deep-water sloughs with sawgrass ridges has diminished, and is hypothesized to be a critical control on restoration outcomes. Recently obtained data has been used to assess system-wide microtopographic variation and related factors that were known to influence the effectiveness of flow restoration. Our study used landscape analysis and results from hydrologic modeling to predict how ridge-slough patterning would be affected – the overall goal was to predict ecological outcomes across a range of Everglades restoration options. We are evaluating six metrics of ridge and slough landscape functionality in six sub-basins of the Everglades across four options for restoration ranging from moderate to aggressive. Ridge-slough functionality metrics included microtopographic variation, percent ridge in landscape, strength of directional connectivity of sloughs using a DCI index (Directional Connectivity Index, a relative measure of slough pathway tortuosity and connectedness), predicted flow velocity, flow alignment with primary directional connectivity of sloughs, hydroperiod, and predicted dry, median and wet season water depth. Forecasts of restoration effectiveness were developed across a range of restoration scenarios by combining hydrologic model outcomes with topographic and ecological data to quantify metrics and compare them with values representing a “well-functioning” landscape. Modeling results from the South Florida Water Management Model (SFWMM) were used to simulate present-day hydrology and four possible restoration scenarios. We found that all restoration options are likely to improve the functioning of the ridge-slough landscape relative to a no restoration option, but only certain sub-basins approach are substantially improved toward approximating pre-drainage conditions, i.e., with best results expected in southern Water Conservation Area 3A and Everglades National Park. In contrast, none of the restoration options improved water levels and hydroperiods enough to restore a functional ridge-slough landscape in northern WCA-3A, eastern WCA-3A, or WCA 3B. The costs of expanding water storage and flow and successful development of new technologies also are important in selecting between options. In conclusion we found that the slow expected response of the natural rebuilding of microtopographic variation will limit the effectiveness of flow restoration in highly degraded sub-basins. An encouraging result is that even moderate restoration provides substantial benefits in less degraded areas such as ENP. An important feature of expanding water storage is the flexibility to maintain water levels during challenging environmental conditions, such as potentially drier conditions in the central Everglades during the coming decades.

<u>BIO</u>: Jay Choi received the Ph.D. from Hydrology and Water Resources in University of Arizona and has worked as a Hydrologist at USGS, Reston VA last 10 years. Research interest is hydrologic Transport Processes from Hyporheic Zones to Watersheds, Hydraulic Measurement and Surface Water Transport Modeling, Groundwater/Surface water Interactions, Contaminant Transport Modeling.

<u>Contact Information</u>: Jay Choi, USGS, 12201 Sunrise Valley Reston VA 20192, Phone: 703-648-5418, Email: jchoi@usgs.gov

RECENT HYDROLOGIC CHANGE IN A RAINFALL-DRIVEN WESTERN EVERGLADES SWAMP

***Shawn Clem**[1] and Mike Duever[2]*
[1]Western Everglades Research Center, Audubon Florida, Naples, FL, USA
[2]Natural Ecosystems, Naples, FL, USA

The mosaic of upland and wetland habitats characteristic of the Western Everglades has allowed widespread juxtaposition of development and intact wetlands and provides opportunity to examine wetland impacts due to changes in land use and water management activities. Corkscrew Swamp Sanctuary is a 13,000 acre preserve at the center of the 60,000 acre Corkscrew Regional Ecosystem Watershed (CREW) located on the border of Lee and Collier counties in the Western Everglades. The Sanctuary is home to the largest remaining old-growth stand of bald cypress (*Taxodium distichum*) in the world, the largest historical colony of Wood Storks (*Mycteria americana*) in North America, and numerous threatened plant and animal species.

We examined rainfall, surface water and groundwater at Corkscrew Swamp Sanctuary in the 60 years since the Sanctuary was established. No decadal variation was seen in rainfall patterns (annual or monthly totals) or magnitude or date of annual wet season peak water levels. Using daily staff gauge data we calculated annual hydroperiod at six elevations that correspond with regional habitats: hammock forest, pine forest, wet prairie/scrub/dwarf cypress, freshwater march/pond cypress, mixed swamp/bald cypress and pond. While no decadal change was seen in the hydroperiod of the highest elevation wetlands, hydroperiods of freshwater marsh/pond cypress, mixed swamp/bald cypress and ponds were reduced by 47.1%, 33.7%, and 22.8%, respectively, since the 1960s and 1970s. Examination of cumulative hydroperiod through time suggested the most abrupt decrease in hydroperiod was in 1999-2000, with other notable decreases in the late-1980s and mid-2000s. Hydropattern at two belowground elevations (4.2 and 4.5 m NGVD29) did not vary with decade, but cumulative hydroperiod data also suggested the most dramatic change in groundwater 1999-2000. Hydroperiod at each belowground elevation was shorter in 2000-2015 than in 1975-1999.

Changes in the landscape surrounding Corkscrew since the 1980s offer several potential causes of the reduced hydroperiod we observed in surface and groundwater. Potential stressors include increased agriculture (especially citrus) and associated water management activities, increased efficiency of canals, increased rock mining, and increased residential and municipal water use. We continue to work to understand the timing of land use changes concurrent with changes in hydrology and the geographic extent of hydrologic change. We discuss the potential ecological impacts of this dramatic reduction in wetland hydroperiod, particularly as they apply to Wood Storks and other wading birds, vegetation, fire, and wildlife.

BIO: Dr. Clem is an aquatic ecologist who has worked throughout the Greater Everglades for the past 18 years. She established and directs the Western Everglades Research Center at Corkscrew Swamp Sanctuary where her focus is conducting research and monitoring for science-based conservation and restoration of the Western Everglades.

Contact Information: Shawn Clem, Western Everglades Research Center, Corkscrew Swamp Sanctuary, 375 Sanctuary Road West, Naples, FL, USA 34120, Phone: 239-354-4469, Email: sclem@audubon.org

HISTORICAL PERSPECTIVE ON THE ECOSYSTEM HEALTH OF FLORIDA BAY – A FORAMINIFERAL PROXY FOR SEAGRASS ABUNDANCE

***Laurel S. Collins*[1,2]*, Jie Cheng*[1]*, and James W. Fourqurean*[2,3]

[1]Florida International University, Department of Earth and Environment, Miami, FL, USA
[2]Florida Internationa University, Department of Biological Sciences, Miami, FL, USA
[3]Florida International University, Southeast Environmental Research Center, Miami, FL, USA

In Florida Bay, which drains Everglades National Park, seagrass abundance is well correlated with water quality. Seagrass is rarely preserved in sediments, so fossils cannot be used to examine the long-term record of coastal ecosystem health. To examine historical seagrass abundances of Florida Bay, we used as a proxy the fossil record of benthic foraminiferal species.

Two hundred samples were prepared from six sediment cores taken along a Florida Bay transect. The transect ran from the Trout Cove area adjacent to the northeast coast, through the central bay sites of Russell Key and Bob Allen Bank, and westward to Ninemile Bank that lies at the transition from Florida Bay to the Gulf of Mexico. The cores were dated with ^{210}Pb and ^{14}C methods, and the percentages of seagrass-associated foraminifera (PSAF) assessed. PSAF species were defined as those found more frequently on seagrass than in sediments of the region. To test whether PSAF indicates general seagrass abundance, we compared its 1970-2001 record to the timing of Florida Bay's 1987-1994 great seagrass dieoff that caused sediment resuspension, decline of water clarity, phytoplankton blooms, a sponge die-off and declines in fishery harvests. All cores had lows around 1984-1994 (±2 yr), after which 4 of 5 showed increases, indicating a satisfactory correspondence between the PSAF and seagrass abundance, which enables us to use the PSAF on the long-term historical record.

The PSAF was studied at two time scales: from 1880-2001 (±5 yr) it was compared to known anthropogenic and environmental events; and for the last 4,000 years, since Florida Bay's origin, more general patterns were examined. From 1910 to 1920, when a railroad was built that reduced water exchange, the PSAF decreased in the central bay. The largest change, ca. 1940 and seen in 5 of 6 cores, corresponds to a multi-year drought and hypersalinity; a 1950s drop in PSAF agrees with another drought/hypersalinity. A decrease in PSAF from ca. 1965-1975 to ca. 1985, just before the great seagrass dieoff, occurs in 5 of 6 cores and may be related to the anthropogenic alteration of freshwater input from the Everglades.

Over the last 4,000 years, seagrass abundance fluctuated with amplitudes as great as the last 100 years, but generally increased until the large ca. 1940 drop. Overall, seagrass abundance/water quality was apparently little affected by the initiation of agriculture (ca. 1905). It was greatly affected by multiyear droughts, and gradually decreased after ca. 1965-1975, presumably a result of the construction of canals and water retention areas, which have been implicated by other studies in the degradation of ecosystem health. It remained at relatively low levels after the 1987-1994 seagrass dieoff until at least 2003, when our cores were collected.

BIO: Dr. Collins is a professor of paleontology whose research on foraminifera addresses environmental change. She earned degrees in geology from University of Maryland (B.S.), George Washington University (M.S.), and Yale University (Ph.D.). She has experience with decadal, centennial and millenial scales of change in Florida Bay and Everglades National Park.

Contact Information: Laurel S. Collins, Florida International University, Department of Earth and Environment, AHC5-360, Miami, FL, USA 33199, Email: collinsl@fiu.edu

RISKS FOR FLORIDA'S NATIVE LAND SNAILS AND RESIDENTS FROM THE NEW GUINEA FLATWORM *PLATYDEMUS MANOKWARI*

Timothy M. Collins[1], *Alície Warren*[2]
[1]Florida International University, Miami, FL, USA
[2]Miami-Dade County Parks, Recreation & Open Spaces, FL, USA

The invasive non-native terrestrial New Guinea flatworm (*Platydemus manokwari*) was recently discovered in Florida (Justine et al., 2014, Justine et al., 2015). There are two primary concerns regarding this flatworm. The first is that in other regions where it has been introduced, it has been considered the cause of extinction and/or dramatic decline of native species, particularly land snails, and for this reason is considered one of the World's 100 worst invasive species. Because of this history and given that we observed a large-scale predation event on native Florida tree snails by *Platydemus manokwari* flatworms in August/September of 2015 in Castellow Hammock Complex Preserve, concern is acute for the iconic land snails of south Florida, including *Liguus* and *Orthalicus* spp. The distribution and abundance of *Platydemus* in Florida is, however, unknown at present, particularly near populations of native snails. The mechanisms by which *Platydemus* may be spreading through the state are also unknown. This basic information is required in order to determine the possible impacts of this species in Florida, and to mitigate its further spread.

In addition, *Platydemus* flatworms are a host for the rat lungworm *Angiostrongylus (Parastrongylus) cantonensis*, a nematode that causes eosinophilic meningitis in humans and other primates. We do not know whether populations of *Platydemus* in Florida are infected with *Angiostrongylus*.

As a first step in clarifying the possible impacts of *Platydemus* in Florida, we are working to: 1) determine the extent and genetic identity of populations of *Platydemus* flatworms in Florida, particularly near populations of imperiled species such as *Liguus* and *Orthalicus* spp. 2) Given that *Platydemus* flatworms are reported to have limited natural dispersal, clarify the mechanisms by which they are spreading through the state 3) Determine the presence/prevalence of *Angiostrongylus* species in selected *Platydemus* populations. 4)Determine predation effects of *Platydemus* flatworms on *Liguus* and *Orthalicus* spp. tree snail populations in Castellow Hammock Complex Preserve as a test case of *Platydemus manokwari* effects on native south Florida tree snail populations.

BIO: Dr. Collins is a professor in the Department of Biological Sciences at Florida International University with expertise in molecular systematics, phylogenetics, invertebrate systematics, and the genetics of invasive species.

Contact Information: Timothy Collins, Dept. of Biological Sciences, Florida International University, OE Bldg., Rm. 167, 112th Ave and SW 8th St., Miami, Florida 33199, Phone: (305) 348-1730, Email: collinst@fiu.edu

EXPLORING THE POTENTIAL OF GROUND PENETRATING RADAR (GPR) FOR DELINEATING THE EXTENT OF BURNED PEAT SOILS IN PALANGKARAYA, INDONESIA

Xavier Comas[1], *Neil Terry*[2], *Matthew Warren*[3], *Agus Kristiyono*[4], *and Daniel Murdiyarso*[5]

[1]Department of Geosciences, Florida Atlantic University, Davie, FL, USA
[2]United States Geological Survey, Storrs, CT, USA
[3]USDA Forest Service, Northern Research Station, Durham, NH, , USA
[4]BPPT, Indonesian Agency for Assessment and Application of Technology (BPPT), Jakarta, Indonesia
[5]Center for International Forestry Research (CIFOR), Bogor, Indonesia

For thousands of years, tropical peat swamp forests have sequestered atmospheric carbon in thick layers of waterlogged, partially decomposed plant material (peat). Indonesia contains roughly half of the World's tropical peatlands, which are known to be globally significant carbon pools. Drainage and burning associated with peat swamp forest degradation, deforestation and land conversion are now Indonesia's largest source of greenhouse gas emissions. Therefore, avoiding emissions from peatland conversion is an essential consideration for national climate mitigation strategies in Indonesia and other tropical countries where forested wetlands are threatened. The central part of Kalimantan (Indonesia) recently recoded the worst wave of forest fires for the last 20 years, with more than 300 localized fires during October of 2015. Fires were due to a combination of anthropogenic peat drainage and seasonal clearing of forest, over an extended drought period associated with a strong El Niño. While several recent studies have investigated the effect of peat fires in terms of gas emissions, little is known about the effect of fire for peat below the surface. In this study we tested the potential of ground penetrating radar (GPR) to investigate the lateral extent of burned peat below the subsurface at several drained sites in Palangkaraya, one of the hotspots of the extensive peat fires in Central Kalimantan during 2015. Our results show that: 1) burned sites are characterized by higher electromagnetic (EM) wave velocities when compared to unburned sites; 2) marked lateral changes in EM wave velocity of the peat column are most likely related to differences on how peat burns with depth (i.e. changes in properties of the peat matrix); and 3) the GPR reflection record may show differences between unburned and burned portions of the peat column and therefore shows the potential of GPR for delineating the extent of burned peat.

BIO: Xavier Comas is an Associate Professor in the Department of Geosciences at Florida Atlantic University with more than 10 years of experience and over 30 publications in the use of near-surface geophysical methods in peat soils (as applied to carbon studies) in both subtropical and boreal systems in the US, as well as international locations such as Indonesia, Ecuador, the UK, or Spain.

Contact Information: Department of Geosciences, Florida Atlantic University, 200 College Ave, Davie West Bldg. DW – 330, Davie, FL 33314, Email: xcomas@fau.edu

IDENTIFYING THE EFFECTS OF EUTROPHICATION ON DRIVERS OF ELEVATION CHANGE IN FLORIDA'S MANGROVES

Jeremy Conrad[1,2] *and Brian Benscoter*[2]
[1]U.S. Fish and Wildlife Service, Sanibel, FL, USA
[2]Florida Atlantic University, Davie, FL, USA

Coastal mangrove forests around the globe are at risk of being submerged due to sea level rise (SLR). Their vulnerability and resiliency to SLR is dependent upon their overall health and ability to build and gain vertical elevation. Vertical land movement can be attributed to the net result of a few primary processes; sedimentation, belowground root production, plant litter deposition, decomposition, erosion, and algal mat development. The combination of these processes results in a change in the substrate's elevation. In a few Caribbean locations, mangroves have been found to completely or partially offset rising sea levels through the production of below ground root structure and or accumulation of new sediments. However, anthropogenic disturbances can degrade mangrove forest health and result in the loss of vertical elevation through erosion, decomposition, and peat collapse. Mangrove's resiliency to SLR is dependent upon their resiliency to anthropogenic disturbances.

A major threat to mangrove forest health is anthropogenic eutrophication of coastal wetlands. Mangrove forests are oligotrophic systems that are sensitive to eutrophication. Nutrient availability and conservation are drivers of forest structure; however, little is known about the short and long-term effects of eutrophication on mangrove forest health and more specifically the drivers of vertical elevation movement. The goal of this project is to assess how the addition of nutrients to a mangrove forest will affect their vertical land building mechanisms and ultimately their resiliency to SLR.

The J.N. "Ding" Darling National Wildlife Refuge is comprised of nearly 8,000 acres of tidal estuary mangrove forests and located on Sanibel Island Florida, 6.5 KM south of the mouth of the Caloosahatchee River. The Caloosahatchee River is the main flood control for Lake Okeechobee and as a result, discharges from the Lake deliver large amounts of eutrophic freshwater into the estuarine mangrove forests of the Refuge. The history of freshwater discharges has created a seasonal nutrient gradient across the Refuge. To better understand how the drivers of vertical land movement are influenced by eutrophication from terrestrial systems, we have established 18 experimental plots with three nutrient treatments (Phosphorus, Nitrogen, and Control) in two hydro-geomorphic zones across the refuge. Within each plot and nutrient treatment, we are utilizing surface elevation tables (SETs) and marker horizons (MH) to assess the effects of the nutrient treatments and gradient on the mechanisms of elevation change. The results of this project will provide land managers, such as USFWS, an understanding of what drives elevation change in Florida's mangroves and how management activities on terrestrial ecosystems could impact coastal wetlands health, vulnerability, and resiliency to SLR.

BIO:

Contact Information: Jeremy Conrad, 1 Wildlife Dr, Sanibel, FL 33957, USA, Email: Jeremy_Conrad@fws.gov

APPLICATION OF THE COASTAL SALINITY INDEX TO SITES IN FLORIDA BAY AND THE GULF OF MEXICO

***Paul Conrads*[1] *and Bryan McCloskey*[2]

[1]U.S. Geological Survey, South Atlantic Water Science Center, Columbia, SC, USA

[2]Cherokee Nation Technologies, contracted to the U.S. Geological Survey, St. Petersburg Coastal & Marine Science Center, St. Petersburg, FL, USA

Coastal droughts have a different dynamic from upland droughts, which are typically characterized by agricultural, hydrologic, meteorological, and (or) socioeconomic impacts. The location of the freshwater-saltwater interface in surface-water bodies is an important factor in the ecological and socioeconomic dynamics of coastal communities. Because of the uniqueness of drought impacts on coastal ecosystems, a Coastal Salinity Index (CSI) was developed by using an approach similar to the Standardized Precipitation Index (SPI). Instead of using precipitation data, as with the SPI, the CSI utilizes salinity data. The CSI is a standardized probability index with zero indicating historical median salinity amount, and positive and negative values representing increasingly fresh and saline conditions, respectively. The CSI is computed for various time scales to capture short- and long-term conditions. Evaluation of the CSI indicates that the index can be used for different estuary types (for example: brackish, oligohaline, or mesohaline), for regional comparison between estuaries, and as an index for wet conditions (high freshwater inflow) in addition to drought (saline) conditions.

The CSI characterizing 1- to 24-month duration salinity conditions was computed for five tributary sites in Florida Bay and for nine tributary sites in the Gulf of Mexico. Comparison of the CSIs using the same time intervals shows how the intensity of drought and freshwater conditions varies along the southwest Florida coast. Time-series plots showing the CSI index for all the computed time scales show how sites vary in response to short- and long-term conditions. To evaluate the effectiveness of the CSI as a prediction and adaptive management tool, there is a need to develop linkages between the CSI and coastal drought response variables. However, identifying potential coastal drought response datasets is challenging. Coastal drought is a relatively new concept and existing datasets may not have been collected or understood as "drought response" datasets. Potential coastal drought response datasets include tree growth and liter fall, harmful algal bloom frequency, *Vibrio* infection occurrence, sportfish populations, and shellfish harvesting data. The CSI computed for Florida Bay shows a strong visual correlation with the occurrence of harmful algal blooms along the coast. The presentation will describe the application of the CSI to sites along the Gulf of Mexico and Florida Bay.

Bio: For the past 30 years Paul has worked with the USGS in the South Atlantic Water Science Center in a variety of activities – principally data collection, data analysis, and hydrodynamic and water-quality model applications. For the past eleven years he has been working on various projects in the Florida Everglades.

Contact Information: Paul A. Conrads, U.S. Geological Survey, South Atlantic Water Science Center, Stephenson Center, Suite 129, 720 Gracern Road, Columbia, SC 29210 USA, Phone: (803) 750-6140, Email: conrads@usgs.gov

USE OF EVERGLADES DEPTH ESTIMATION NETWORK (EDEN) TO DEVELOP WATER-LEVEL GRADIENTS AND FLUXES

Paul Conrads[1] *and Eric Swain*[2]
[1]U.S. Geological Survey, Columbia SC, USA
[2]U.S. Geological Survey, Fort Lauderdale, FL USA

The Everglades Depth Estimation Network (EDEN) is an integrated set of tools that utilizes water-level gages, interpolation models, and other analyses to represent hydrologic data across the freshwater part of the greater Everglades. One of the primary EDEN products is a representation of the water-level surface based on the measured data from the gaging station network. In conjunction with topographic information, a continuous map of water depth can be generated on a daily basis. This provides essential wetland inundation and hydro-period information for ecologists and water managers. EDEN also contains additional tools that help users analyze the water-level data for specific ecological and water supply applications. However, estimates of flow direction and rate, implicit in the water-surface representation, would greatly expand the utility of EDEN data.

Representation of water-level surface from EDEN can be used to estimate a gradient and direction of flow at any point. To refine the estimates of flow velocities from water-level gradients requires representative frictional resistance values. Several maps of estimated frictional resistance have been developed for numerical models, based on vegetation type and density, and water depth. Therefore, to better determine the frictional resistance, the EDEN water-level data in each cell were grouped by vegetation type.

The accuracy of the water-level gradient estimate is sensitive to the accuracy of the water levels. The Everglades is a very low-gradient system, with water slopes on the order of 1.5 inches per mile, so small-magnitude errors in water level can cause relatively large percent errors in computed gradients. These errors are not as critical when considering the water surface and depths, but when using the gradients to estimate velocities and fluxes, more critical errors can result. These errors are indicative of small errors in the water-level gages and, if properly identified, can be used to improve elevation measurements in the EDEN network. Sparse field velocity measurements were made in the Taylor Slough area of Everglades National Park on several occasions in 1996 and 1997, and continuous measurements in Shark Slough for periods within the 1999-2002 period. An initial comparison with EDEN-predicted flow vectors helps to delineate the accuracy and pinpoint possible sources of datum errors.

Future efforts involve combining the estimated velocity vectors with the water-level depth map to generate specific discharge and volumetric flux maps. This would allow comparison with flow-measurement sites in coastal rivers along the Gulf of Mexico and Florida Bay coastal boundaries. This comparison would integrate these major data-collection projects and provide large-scale mass budget information for water managers in more detail that has been previously possible.

Bio: For the past 30 years Paul has worked with the USGS in the South Atlantic Water Science Center in a variety of activities – principally data collection, data analysis, and hydrodynamic and water-quality model applications. For the past eleven years he has been working on various projects in the Florida Everglades.

Contact Information: Paul A. Conrads, U.S. Geological Survey, South Atlantic Water Science Center, Stephenson Center, Suite 129, 720 Gracern Road, Columbia, SC 29210 USA, Phone: (803) 750-6140, Email: conrads@usgs.gov

USING THE EVERGLADES DEPTH ESTIMATION NETWORK (EDEN) TO CHARACTERIZE COASTAL SALINITY CONDITIONS

Paul Conrads[1] *and Bryan J. McCloskey*[2]
[1]U.S. Geological Survey, South Atlantic Water Science Center, Columbia, SC, USA
[2]Cherokee Nation Technologies, contracted to the U.S. Geological Survey, St. Petersburg Coastal & Marine Science Center, St. Petersburg, FL, USA

In addition to water-level data used by the Everglades Depth Estimation Network (EDEN) to generate daily water-surface and water-depth maps, the network of gages includes salinity and temperature data for the oligohaline/mesohaline zone in the Southern Everglades. Salinity, along with water temperature, are critical variables for the biological viability of many species and are the basis for many of the Everglades Restoration performance measures. The location of the freshwater-saltwater interface in surface-water bodies is an important factor in the ecological and socioeconomic dynamics of coastal communities. These coastal areas, or specifically the coastal oligohaline wetlands zone (sometimes referred to as “the coastal fringe” or the “zone of change”), are critical in evaluating the hydrologic and ecological response to modifications of the water delivery system related to restoration and by future climate change. Hydrologic changes, either from flow alterations or climate change, will first be manifested along this coastal fringe. These areas experience tidal backwater conditions and increases in flow and(or) sea-level rise may move this area inland. Coastal areas will probably exhibit larger relative changes in hydroperiods as compared to inland areas.

Two products have been added to EDEN to evaluate current and long-term salinity conditions–salinity duration hydrographs and coastal salinity indices. To evaluate current salinity and temperature conditions relative to the ranges of historical salinity experienced at a site, salinity duration hydrographs (similar in concept to flow and(or) water-level duration hydrographs) are generated which overlay the current salinity values on the monthly historical range of the salinity data. Thus, one can quickly evaluate whether current conditions are fresher (less saline) or saltier than normal. Current water temperature also is shown on these graphs. For evaluating short-, medium-, and long-term salinity conditions, the Coastal Salinity Index (CSI) is computed for those EDEN sites that have salinity data. The CSI was developed by using an approach similar to the Standardized Precipitation Index (SPI), utilizing salinity data rather than precipitation data. The CSI is a standardized probability index with zero indicating historical median salinity, and positive and negative values representing increasingly fresh and saline conditions, respectively. The CSI is computed over various time scales to capture short- and long-term trends. Evaluation of the CSI indicates that the index can be used for different estuary types (for example: brackish, oliogohaline, or mesohaline), for regional comparison between estuaries, and as an index for drought (saline) conditions in addition to wet (high freshwater inflow) conditions.

Bio: For the past 30 years Paul has worked with the USGS in the South Atlantic Water Science Center in a variety of activities – principally data collection, data analysis, and hydrodynamic and water-quality model applications. For the past eleven years he has been working on various projects in the Florida Everglades.

Contact Information: Paul A. Conrads, U.S. Geological Survey, South Atlantic Water Science Center, Stephenson Center, Suite 129, 720 Gracern Road, Columbia, SC 29210 USA, Phone: (803) 750-6140, Email: conrads@usgs.gov

INVESTIGATING ACTIVE MARSH IMPROVEMENT APPROACHES FOR RESTORING WATER BIRD HABITAT IN THE P-ENRICHED EVERGLADES

***Mark I. Cook**, Susan Newman, Michael Manna, LeRoy Rodgers, Christa Zweig*
South Florida Water Management District, West Palm Beach, FL, USA

Half a century of anthropogenic phosphorus inputs to the oligotrophic Everglades has caused a regime shift from the original sawgrass (*Cladium jamaicense)* ridge and slough matrix to 14,000 ha of dense emergent vegetation dominated by cattail (*Typha* spp). This regime shift is inherently resilient to natural recovery because the internal cycling and feedbacks of the ecosystem have changed. Recovery of these impacted areas requires not only a reduction in the external phosphorus inputs but also management activities that weaken the resistance of the cattail regime.

A key constraint in ecosystem function is the high density of the emergent vegetation, which results in net heterotrophic production and limits access to wildlife. A series of landscape-scale experiments were initiated to examine whether managing for open-water habitat within the dense vegetation, using herbicide application and controlled burning, can recover enriched areas of the Everglades (Water Conservation Area 2A). The initial experiment examined whether open plots (6.25 ha) would sufficiently alter trophic dynamics such that aquatic fauna and water bird diversity and abundance is increased. The results revealed a significant increase in the proportion of open-water habitat, increased dissolved oxygen concentrations, primary productivity, and aquatic metabolism, and altered structure of macroinvertebrate and fish assemblages relative to vegetated control plots. This in turn provided habitat that attracted large numbers of foraging wading birds and waterfowl that were sustained over the long-term (ten-years). The cattail controls also had ecological value because they supported relatively high densities of crayfish and secretive marsh birds.

The results of this experiment led to two further experiments that examined, respectively, the ability to restore remnant ridge and slough landscape within moderately enriched regions of the Everglades, and the costs and benefits of applying different herbicide/fire combinations. We discuss the efficacy of these approaches in relation to water bird use, and their implications for Everglades restoration and management.

<u>BIO</u>: Dr. Cook is an avian ecologist with 20 years of experience studying waterbirds. His research focuses on how wetland processes such as hydrology and nutrient run-off affect wading bird foraging and reproductive success. The goal is to help restore and manage wading bird populations in the Everglades.

<u>Contact Information</u>: Mark I. Cook, Everglades Systems Assessment Section, Applied Sciences Bureau, Water Resources Division, South Florida Water Management District, P.O. Box 24680, West Palm Beach, FL 33416-4680, USA, Phone: 561-686-8800 x4539,
Email: mcook@sfwmd.gov

FUSING LIDAR WITH RTK GPS USING RANDOM FOREST REGRESSION SHOWS PROMISING FOR DEMS OF MANGROVE AND SAWGRASS SOIL HEIGHTS IN FLORIDA'S COASTAL EVERGLADES

Hannah M. Cooper *and Caiyun Zhang*
Florida Atlantic University, Boca Raton, FL, USA

Low (better) vertical accuracy Digital Elevation Models (DEMs) are needed to support Florida Everglades restoration efforts. The Everglades community agreed upon the need for elevation data with a vertical accuracy threshold of +/- 15 cm referenced to the North American Vertical Datum of 1988 (NAVD 88) (e.g. Jones et al., 2012). Wetland habitats such as those unique to the coastal Everglades pose a challenge for remote sensing technologies such as Light Detection and Ranging (LiDAR) to meet this vertical accuracy requirement. For this study, a framework was designed to integrate LiDAR data with Real Time Kinematic (RTK) Global Positioning Systems (GPS) measurements for modeling mangrove swamp and sawgrass marsh soil heights. Random Forest Regression, an ensemble learning method, was utilized to combine the two data sources and generate a DEM. The Random Forest Regression DEM was then compared with the commonly used bias correction procedure where LiDAR elevations are reduced by the mean error associated with each vegetation community type. Random Forest Regression produced the best result with a consolidated vertical Root Mean Square Error ($RMSE_Z$) of 9 cm and 13 cm at the 95th percentile, and vertical bias of 1 cm. This study demonstrates the favorable ability of fusing LiDAR with RTK GPS using ensemble learning techniques to model soil elevation heights in complex coastal environments.

<u>BIO</u>: Hannah Cooper is a coastal geographer and Geosciences PhD candidate at Florida Atlantic University. Hannah's bachelor's and master's degrees are in Geography from the University of Hawai`i at Mānoa where she was a research assistant for the Hawai`i Coastal Geology Group. Hannah's multidisciplinary research integrates Earth science, human-environmental interactions, GIS, remote sensing, statistical modeling, and field measurements to better understand dynamic geographic phenomena such as the current and future impacts of accelerated sea-level rise on natural and human coastal systems

<u>Contact Information</u>: Hannah M Cooper, Department of Geosciences, Florida Atlantic University, 777 Glades Rd., Boca Raton, FL 33431, Email: hcooper2013@fau.edu, Website: http://student.fau.edu/hcooper2013/web/Index.htm

INFLUENCE OF FLOATING AQUATIC VEGETATION ON ENVIRONMENTAL PARAMETERS AFFECTING PHOSPHORUS REMOVAL IN THE EVERGLADES AGRICULTURAL AREA

*Samira H. Daroub[1], **Jennifer A. Cooper[1]**, Anne E. Sexton[1] and Timothy A. Lang[1]*
[1]University of Florida Everglades Research and Education Center, Belle Glade, FL, USA

Phosphorus has been identified as a contributor to the diminished environmental and water quality of the Everglades National Park. Water from Lake Okeechobee passes through the Everglades Agricultural Area (EAA) before being discharged to the Everglades National Park. Discharges from the EAA have been identified as contributors to the P enrichment in the everglades. The EAA basin, comprised of approximately 250,000 ha of farm land is a highly productive agricultural area of near neutral to slightly alkaline organic soils used to grow sugarcane, vegetable, sod and rice. The Everglades Forever Act requires a reduction of P loads from the EAA in excess of 25%, relative to the baseline period of data collected between 1979 and 1988. The best management practices (BMP) program was initiated the help reach this goal, and since it's full implementation in 1995 has achieved an average P load reduction of 56% (as of Water year 2015) from the EAA.

Research and testing of new BMPs is conducted to provide farmers with new options and opportunities for P reduction in the EAA. Currently, management of floating aquatic vegetation (FAV) is under review as a potential new BMP. Control of sediment is key to P management, as export of sediments off farm will carry absorbed P with it. While FAV may serve as temporary storage of P through uptake in plant biomass, initial results have suggested that formation of low density detrital material following FAV senesce increased suspended particulate matter and may increase transport of P off farm with particulate matter. Eight experimental farms have been monitored for P content and FAV coverage, along with environmental parameters important for P cycling (pH, total suspended solids, calcium, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential) since February 2011. Average annual percent FAV coverage ranged from 0.0 to 44%; average annual total P concentrations ranged between 40 – 357 ppb. Linear regression analysis indicated a significant positive relationship between FAV (% coverage) and total P discharges, indicating that the presence of more FAV correlated with higher total P discharges from EAA farms. Significant relationships were also observed between FAV coverage and pH, total suspended solids, calcium, oxidation-reduction potential and dissolved oxygen. Significant relationships were not observed between FAV coverage and specific conductance and temperature. Further analysis of these relationships will assist in elucidation of which environmental parameters are more important for prevention of P export off-farm. Our results suggest that management of FAV may provide and effective new BMP and assist in further efforts to restore the everglades.

<u>BIO</u>: Dr. Cooper is a postdoctoral research assistant working on phosphorus best management practices with Dr. Samira Daroub in the Everglades Agricultural Area. Her background is in chemistry and her previous research experience includes study of C, N and P cycling in soil-based onsite wastewater treatment systems.

<u>Contact Information</u>: Jennifer Cooper, Soil and Water Science, 3200 E. Canal St., Belle Glade, FL, USA 33430, Phone: 707-470-6398, Email: jencooper@ufl.edu

EFFECT OF INCREASED SHEETFLOW ON SEDIMENT TRANSPORT AND DYNAMICS ALONG THE L67C CANAL

Carlos A. Coronado[1], *C.J. Saunders*[1], *F. Sklar*[1], *C. Hansen*[2], *F. Santamaria*[1], *D. Marley*[1], *and M. Blaha*[1]
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]Florida International University, Miami, FL, USA

Important advances have been made in understanding the mechanisms of landscape formation and degradation from small scale experiments and large-scale modeling. It is widely recognized that restored sheetflow is critical in rebuilding the patterned, corrugated landscape of the Everglades. Modeling studies indicate water velocities >2 cm s^{-1}, several-fold higher than measured in the current system, may be needed to sufficiently entrain and redistribute sediment to build landscape patterning and topography. Empirical evidence required for a landscape-scale test of this hypothesis is lacking, and scientific and engineering uncertainties remain over how fast the ridge and slough landscape will respond to restored sheetflow. The Decomp Physical Model (DPM) is a landscape-scale experiment (~15-km^2) quantifying the benefits of sheetflow and canal-backfilling on Everglades ridge-and-slough wetlands. Even with restored sheetflow and levee removal, it is unknown as to what extent the existing canals will hinder the restoration of the ridge and slough landscape. In this regard, key restoration uncertainties include (1) the extent to which canals must be backfilled to ensure the restoration of sheetflow and sediment redistribution and (2) the extent to which canals may possibly release high-nutrient sediments downstream under restored sheetflow conditions.

Methods

To capture vertical sediment deposition in canals, three sets of vertical sediment traps per treatment were suspended 1 m above the sediment-water interface. Canal trap deployments are synchronized with marsh trap deployments. Samples collected from all sediment traps were stored cold and transported to the lab for processing.

Results and Discussion

While flows around the L-67C gap are quite variable spatially; nonetheless results from the three flow events indicate that two thirds of water discharges from the S152 culverts flow directly east into the north end of the L67C canal and then south along the L67C canal into the backfill treatment area. Due to this flow pattern, the effect of high flows and sediment is not even among the three backfill treatment areas with higher sediment deposition being higher at the northern control site and non-backfill canal sites. These results suggest that backfill sediment dynamics may be strongly influenced by velocity changes within the canal and sediment transport within the upstream portions of the canal. Given the high total phosphorus (TP) of canal sediments, quantifying sediment and P loads throughout the canal and backfill areas is a critical next step for the canal study.

Contact Information: Carlos A. Coronado, Everglades Systems Assessment, South Florida Water Management District, 3301 Gun Club Rd., West Palm Beach, FL 33406, Phone: 561 682-6205, Email: ccoron@sfwmd.gov

PRE-RELEASE IMPACT ASSESSMENTS OF *CALOPHYA* SPP. LEAF GALLING PSYLLIDS (HEMIPTERA: CALOPHYIDAE), CANDIDATE BIOLOGICAL CONTROL AGENTS OF BRAZILIAN PEPPERTREE (ANACARDIACEAE)

James P. Cuda[1], *Patricia Prade*[2], *William A. Overholt*[2], *Rodrigo Diaz*[2], *and MarceloVitorino*[3]
[1]University of Florida, Gainesville, FL, USA
[2]UF/IFAS Indian River Research & Education Center, Ft. Pierce, FL, USA
[3]Universidade Regional de Blumenau, Blumenau, Santa Catarina, Brazil

Brazilian peppertree, *Schinus terebinthifolia* Raddi (Anacardiaceae), is an invasive, rapidly colonizing woody shrub of disturbed habitats, natural communities and conservation areas predominantly in central and south Florida, particularly the Everglades. The state of Florida spends millions of dollars annually controlling large infestations of Brazilian peppertree on public lands primarily by burning, physical extraction and herbicides. Biological control with host specific natural enemies would be a more environmentally sustainable management tactic because no native relatives of the genus *Schinus* (the taxonomic group to which Brazilian peppertree belongs) occur in the US, and this control method can be integrated with conventional control practices. One of the objectives of our research program is to examine the host specificity/ impact of candidate biological control agents on Brazilian peppertree. We are currently studying several species of psyllids in the genus *Calophya* Löw (Hemiptera: Calophyidae) from Brazil.

Three *Calophya* spp. that are native to South America have been collected only from Brazilian peppertree. They deposit their eggs along leaflet margins and veins, and nymphs complete their development in open pits galls. A new generation is produced in ~40 days. The developing psyllids damage plants by reducing leaflet performance and survival, which inhibits plant growth. Laboratory host range studies with two of the psyllids (*Calophya latiforceps* Burckhardt and *C. terebinthifolii* Burckhardt & Basset) showed these species reproduced only on Brazilian peppertree. Eggs laid on non-target plants hatched, but nymphs were not able to complete development to the adult stage because of their inability to induce gall formation. A replicated field study with *C. terebinthifolii* in Brazil also indicates these insects are capable of impacting Brazilian peppertree by diverting resources away from flower and fruit production. Because of the host specificity exhibited by *C. latiforceps* in laboratory tests, a petition (TAG No. 15-02) was prepared requesting approval for its release in Florida. The USDA APHIS federal interagency Technical Advisory Group for Biological Control Agents of Weeds recommended field release on 8 April 2016. A release permit is pending review of biological and environmental assessments by APHIS PPQ.

BIO: Dr. James P. Cuda is a Professor and Fulbright Scholar in the Entomology & Nematology Department. His research involves sustainable management of invasive weeds with a focus on biological control. He has received nearly $2.5 million in research funding from state and federal agencies over the past 10 years.

Contact Information: James P. Cuda, Charles Steinmetz Hall, University of Florida, PO Box 110620, Gainesville, FL 32611 USA, Phone: 352-273-3921, Email: jcuda@ufl.edu

HYPERSALINITY IMPACTS ON SEAGRASS AND MOLLUSCAN COMMUNITIES IN WESTERN FLORIDA BAY

***Andre Daniels**[1] and Bethany Stackhouse[2]*
[1]U.S. Geological Survey, Davie, FL, USA
[2]U.S. Geological Survey, Reston, VA, USA

Drought conditions during 2015 had a major impact on water quality in Florida Bay. Several basins experienced sustained salinity levels over 65 ppt. in early 2015. Due to these hyper-saline conditions, *Thalassia testudinum, Halodule wrightii,* and *Syringodium filiforme* began to die-off. Many acres of seagrass habitats were lost. In September of 2015, we began to assess the impact of the die-off in Rankin Basin, Johnson Key Basin, Rabbit Key Basin, and Whipray Basin. We focused on water quality, seagrass diversity and densities, and mollusk species diversity and abundance.

Seagrasses and macroalgae species were evaluated using the Braun-Blanquet method to determine abundance, density, and species frequency. Substrate types and depths were also recorded. Live and recently dead (pristine shells) mollusks were collected from grass blades and the substrate. We recorded species diversity and abundance for all mollusks. We compared pre and current die-off conditions with Braun-Blanquet data from our 2005-2011 Fish and Invertebrate Assessment Network Project (FIAN). Rabbit Key Basin did not experience any decline in sea grass coverage. We estimated about a 30%-40% loss of seagrass coverage in and around Johnson Key during the dry season of 2016, but the basin is currently recovering. Large patches of healthy *Thalassia testudinum* and *Halodule wrightii* shoots have been documented. Rankin Key Basin, which had a 90% loss during the die-off, is also starting to show signs of recovery. Several species of macroalgae and *Halodule wrightii* have been found throughout several transects. Data collection started in early 2016 for Whipray Basin where seagrass has always been patchy. Dense *Thalassia testudinum* beds have been found throughout the basin and currently there are signs of die-off. Turbidity levels in Whipray Basin were at the highest levels in October 2016. Significant layers of detritus were present as well. Overall, there was a 60%-94% decrease in live mollusks from samples collected in November 2015 compared to September 2015 throughout Rankin, Johnson Key, and Rabbit Key basins. Salinity levels returned to normal during the wet season of 2016. Most of the floating seagrass as well as the dense layers of detritus have been flushed from Rankin and Johnson Key Basins. We will continue to monitor all four basins for future assessments.

BIO: Andre Daniels is currently a Research Fisheries Biologist with the United States Geological Survey (USGS) at the Center for Collaborative Research at NOVA Southeastern University. Andre specializes in biota diversity in seagrass communities in South Florida.

Contact Information: Andre Daniels, Wetlands and Aquatic Research Center, U.S. Geological Survey, 3321 College Avenue, Davie, FL 33314 USA, Phone: 954-377-5918, Email: andre_daniels@usgs.gov

EPISODIC DISTURBANCE EFFECTS ON FLORIDA COASTAL EVERGLADES WATER QUALITY

***Steve Davis*[1]**, *John Kominoski*[2], *Ross Boucek*[2], *Edward Castañeda*[2], *Joffre Castro*[3], *Shimelis Dessu*[2], *Evelyn Gaiser*[2], *Jay Sah*[2], *Donatto Surratt*[3] *and Tiffany Troxler*[2]

[1]The Everglades Foundation, Palmetto Bay, FL, USA
[2]Florida International University, Miami, FL USA
[3]Everglades National Park, Homestead, FL, USA

Water quality is an important driver of ecological processes such as primary production and respiration in aquatic ecosystems. In Everglades National Park (ENP), water column concentrations of Phosphorus are of the utmost concern in the oligotrophic sawgrass-dominated marshes, as they are directly linked to threshold-related changes in periphyton composition and ultimately to directional shifts in marsh vegetation community structure. Changes in Nitrogen loading or the availability of Nitrogen relative to Phosphorus (i.e., N:P ratios) also play a role, particularly at the mangrove ecotone and estuarine zone, where transformational processes and possibly N-limitation become more prevalent.

Agricultural sources of pollutants to the Everglades have been well-documented and sources of inflow are regularly monitored. However, little work has been done to understand the effects of episodic disturbance on the dynamics of water quality within this oligotrophic ecosystem. This study aims to characterize event-driven changes in ENP water quality in order to understand the importance of different events (e.g., hurricanes, fire, etc.) in space and time. This is particularly important given the sensitivity of the Everglades to changes in nutrient availability and the legal measures that have been put into place to protect its integrity.

The Florida Coastal Everglades Long Term Ecological Research program has been monitoring water quality at locations along Taylor Slough (TS) and Shark River Slough (SRS) for 16 years. In the wetland sites, automated water samplers collect 250 ml sub-samples every 18 hours, resulting in 1-liter 3-day composited samples. These tri-daily samples are retrieved every 3 to 4 weeks then analyzed for Total Nitrogen (TN), Total Phosphorus (TP), and salinity—where applicable. This database spans a number of large-scale disturbance events such as Hurricane Wilma in 2005 and a record cold spell in early 2010. There were also multiple fires and marsh dry-down events that occurred on or near water quality stations, and instances of operational changes at sites near inflow sources affecting water quality.

Hurricane Wilma had the most dramatic and lasting impact on water quality in mangrove sites along SRS. The deposition of marine-derived sediment from Wilma more than doubled mean TP in the mangrove zone for as long as 5 years. Extraordinarily high TN concentrations were noted in marsh sites in upper SRS during and immediately following the cold spell of 2010 and may be linked to the extensive fish kills and leaf litter production produced by the excessive cold. Other disturbances, including 8 fires that encompassed several SRS sites between 2001 and 2014 and marsh dry-down events in 2001, 2004, 2007, and 2011, also appear to have distinct water quality signatures. These latter disturbances have clear implications on peat soil conservation and speak to the need for flow restoration.

BIO: Steve has 20+ years of Everglades research experience, including the past 8 years as The Everglades Foundation's Ecologist. Research includes the role of episodic disturbance and freshwater inflows in regulating biogeochemical processing of carbon, nitrogen, and phosphorus and resultant effects on patterns in wetland and estuarine water quality and productivity.

Contact Information: Steve Davis, The Everglades Foundation, 18001 Old Cutler Rd., Suite 625, Palmetto Bay, FL 33157, USA, Phone: 786-249-4460, Email: sdavis@evergladesfoundation.org

AN OVERVIEW OF INNOVATIVE MODELING APPLIED TO RESTORATION ECOLOGY

Donald L. DeAngelis
U. S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

The point has often been made in the literature that the path from the orderly world of ecological theory to the complex real world of ecological restoration is not an easy one. The tasks of restoration involve ecosystems that are spatially heterogeneous, nonlinear, far from equilibrium, and driven by highly variable natural forces and deleterious human impacts. This is as true of the Greater Everglades as of any other ecological system undergoing restoration. A hydrology greatly altered from natural, a rising sea level, and invading species are just a few of the problems facing restoration. There is a need for models that allow one both to understand these impacts and to predict the effects of proposed restoration efforts. The models and modeling approaches reviewed here are innovative in the way they address the complexity of Great Everglades and nearby environments and in their aim at making specific predictions. First is the recently developed Empirical Dynamic Modeling approach to forecast “red tides”. Second is the Comprehensive Aquatic System Model, which permits examination of the effects of multiple stressors on spatially distributed food webs. Third, the GEFISH model, allows one to forecast the effects of hydrologic scenarios in the complex Everglades landscape on the production and concentration of fish needed to support higher trophic levels. Fourth, a coupled hydrology-vegetation simulation model, MANHAM, is used in combination with stable isotope measurements to forecast changes in coastal vegetation due to salinity intrusion due to seal level rise and storm surges. Finally, the application of individual-based modeling helps predict the long-term influence of measures of control of an invading tree species. Examples of application of each of these models are presented and their implications for Everglades restoration discussed.

BIO: Dr. DeAngelis is a Senior Scientist with the U. S. Biological Survey. His has 40 years of experience in the fields of population, community, and ecosystem theory, and in ecological modeling. His primary research is aimed at providing modeling tools to help in Everglades restoration.

Contact Information: Donald L. DeAngelis, Department of Biology, University of Miami, P.O. Box 249118, Coral Gables, FL 33124, USA, Phone: 305-284-1690, Email: don_deangelis@bio.miami.edu

INVESTIGATION OF FACTORS THAT CONTRIBUTE TO VARIATIONS IN MOSQUITOFISH (*GAMBUSIA HOLBROOKI*) MERCURY CONCENTRATIONS IN WATER CONSERVATION AREA 2A

***T. DeBusk*[1], *F. Dierberg*[1], *M. Jerauld*[1], *D. Sierer Finn*[1], *J. Potts*[1], *and N. Larson*[1]**
[1]DB Environmental, Inc., Rockledge, FL, USA

Throughout the Everglades Protection Area (EvPA), which consists of the Water Conservation Areas (WCAs) and the Everglades National Park, variations in sulfate concentrations often are invoked as a factor that can influence mercury (Hg) concentrations in mosquitofish (*Gambusia holbrooki*). Waters in WCA-2A contain the highest sulfate levels in the EvPA (mean of 35.5 mg/L [ReMAP, 2005]), and this marsh also exhibits broad temporal and spatial variations in mosquitofish total Hg (interdecile range of 10 – 140 ng/g [ReMAP, 2005]). The north-central portion of WCA-2A, which became phosphorus (P)-enriched from drainage waters in the late 20th century, typically has exhibited low mosquitofish Hg body burdens, while the central portion of WCA-2A has exhibited high Hg fish levels. This spatial difference in mosquitofish Hg previously has been attributed to a biogeochemical mechanism, in which it is thought that the presumed higher sulfate (and consequently, sulfide) levels in northern WCA-2A reduce inorganic Hg bioavailability, in turn inhibiting the Hg methylation process. From 2013-2015 we performed a series of investigations, focusing on sites in northern (F2) and central (U3) WCA2A to characterize biogeochemical and ecological factors that may influence mosquitofish Hg levels. In addition to measuring total Hg (THg), methylmercury (MeHg), and other key chemical constituents in surface waters and soil porewaters at these sites, we measured stable isotope (^{13}C and ^{15}N) content and Hg concentrations in mosquitofish and other prey items.

During our investigation, total Hg (THg) concentrations in the tissues of mosquitofish at U3 and F2 averaged 107 and 51 ng/g, respectively. Sulfate levels at U3 varied from 20 – 31 mg/L, and were slightly lower at F2, ranging from 18 – 28 mg/L. Mosquitofish THg concentrations were not correlated to surface water dissolved THg, MeHg, sulfate or dissolved organic carbon (DOC). Based on ^{15}N analysis, we found that mosquitofish and likely prey items (amphipod (*Hyalella*), chironomids, and grass shrimp (*Palaemonetes paludosus*)) at U3 occupied higher trophic levels than at F2. In addition, there was a distinct separation in the mosquitofish prey items (i.e., invertebrates) between U3 and F2 according to their ^{13}C ratios.

We hypothesize that the primary producers unique to the study sites (submerged macrophytes and calcareous periphyton at U3; cattail litter and green algae at F2), contribute differentially to trophic transfers of Hg. Such differences in food web structure may account for some of the variability in the mosquitofish Hg body burdens within high sulfate areas of WCA-2A, and potentially, in other regions of the Everglades.

BIO: Mr. DeBusk has 35 years experience in the use of wetlands, macrophyte and algal-based systems for water treatment. He has studied biogeochemical processes in south Florida marshes since the late 1990s.

Contact Information: Thomas A. DeBusk, DB Environmental, Inc., 365 Gus Hipp Blvd., Rockledge, FL 32955, USA, Phone: 321-639-4896, Fax: 321-631-3169, Email: tom@dbenv.com

THE EFFECTS OF WILLOW ENCROACHMENT ON THE RESILIENCE OF PEAT CARBON STORAGE IN AN HERBACEOUS WETLAND

Jessica A. Dell *and Brian W. Benscoter*
Florida Atlantic University, Davie, FL, USA

Woody shrub encroachment by Carolina willow (*Salix caroliniana*) into sawgrass (*Cladium jamaicense*) dominated wetlands is promoted by reduced water levels through water management and anthropogenic activity. This encroachment and expansion of native shrubs into sawgrass marshes has the potential to alter the structure and function of Florida wetland ecosystems due to differences in plant morphology and physiology. This project will examine the impacts of willow encroachment on the resilience of peatland soil carbon storage in the Blue Cypress Marsh Conservation Area within the Upper St. Johns River Basin. We expect willow encroachment to alter peat accumulation and carbon storage by altering primary production, decomposition, and the drivers of these carbon cycling processes. Aboveground and belowground production, litter decomposition, and microclimate features will be assessed along a gradient of increasing willow cover. Production and biomass stocks will be estimated with nondestructive allometric equations and fine root ingrowth bags. Carbon input through leaf litter will be examined with leaf litter traps. The decomposition rates of sawgrass and willow leaf litter and fine roots will be assessed with decomposition bags under reciprocal site-source conditions. We expect willow to increase aboveground carbon storage through greater production while decreasing soil carbon storage by enhancing decomposition. Peatland carbon storage may ultimately be at risk if willow encroachment reaches a level capable of altering the feedback mechanisms maintaining peat accumulation.

BIO: Jessica A. Dell is a Ph.D. graduate student in Dr. Brian Benscoter's lab.

Contact Information: Jessica A. Dell, Integrative Biology, Florida Atlantic University, 3200 College Ave, Davie, FL 33314, USA, Phone: 954-236-1262, Email: jdell2014@fau.edu

STABLE ISOTOPE ECOLOGY OF AMERICAN ALLIGATORS WITHIN THE GREATER EVERGLADES

***Mathew J. Denton*[1]**, *Michiko Squires*[2], *Brian J. Smith*[2], *Frank J. Mazzotti*[2], *Kristen M. Hart*[1], *Laura A. Brandt*[3], *and Michael S. Cherkiss*[1]

[1]U.S. Geological Survey, Wetland and Aquatic Research Center, Davie, FL USA
[2]University of Florida, Fort Lauderdale Research and Education Center, Davie, FL USA
[3]U.S. Fish and Wildlife Service, Davie, FL USA

The American alligator (*Alligator mississippiensis*), perhaps the most recognized symbol of the Everglades, affects nearly all aquatic life in the ecosystem in some way. It is a keystone species, top predator, and an ecosystem engineer that builds holes, trails and nests, providing habitat for diverse plants and animals. Although alligators are abundant throughout Florida in both fresh and saltwater habitats, Everglades populations tend to be at lower density and animals are in poorer overall body condition than those in other parts of their range. Many important questions concerning the effects of Everglades restoration on alligator populations remain unanswered, such as the impacts of de-compartmentalization, and the effects of hydrology on population growth, survival, and body condition. Because of their key ecological role, alligators have been identified as a system-wide indicator of ecosystem health. Long-term monitoring of alligators contributes to understanding how the ecosystem is responding to Everglades Restoration.

From our long-term landscape-scale monitoring program we have been able to document effects of hydropattern on alligator production, movement, and body condition. Using Fulton's *K*, we have documented an overall decline in alligator body condition throughout the Everglades over a 15-year period (2000-2014) at seven different wetland areas. We are now performing analyses to investigate the relationship between this decline and hydrologic variables to establish baselines and examine the current state of Everglades alligator population. Additionally, we have begun using stable isotope analysis (SIA) of carbon and nitrogen (^{13}C and ^{15}N) to examine alligator diet and niche breadth, and how these relate to body condition. Because carbon isotopes are used to identify carbon sources in food web studies and nitrogen isotopes are indicative of trophic position, they have been commonly used in a variety of taxa to measure ecosystem patterns and processes and to monitor changes.

Since 2012, we have been collecting plasma, whole blood, and scute samples from alligators throughout nine sites within the Everglades . By sampling multiple tissues with different turnover rates, we are able to use SIA to estimate trophic position and identify spatial (upland vs wetlands; estuary vs marsh) and temporal variance. We built linear models to determine which variables helped explain variation in isotopic signatures. For carbon, our top model included sample type and area of capture. For nitrogen, the top model included sample type plus area, with an interaction of alligator total length. Alligators within the estuary habitat have a significantly larger niche breadth than those in the marsh, which is likely a function of feeding in both fresh and saline habitats. Analyses of alligators and available resources will allow us to identify shifts in resource use over time in response to restoration efforts.

BIO: Mathew Denton is a biologist with 10 years of experience in Everglades restoration projects. He has extensive experience with stable isotope analysis of various fauna from multiple wetlands. He led several different projects and is dedicated to preserving and restoring wetlands.

Contact Information: Mathew Denton, U.S. Geological Survey, 33, Fort Lauderdale, FL 33314, USA, Phone: 954-377-5960,
Email: mdenton@usgs.gov

FUTURE RAINFALL DEPTH-DURATION-FREQUENCY CURVE ESTIMATES UNDER VARIOUS CLIMATE CHANGE SCENARIOS

Tibebe Dessalegne[1], *Michelle M. Irizarry*[2] *and Jayantha Obeysekera*[1]
[1]Hydrology and Hydraulics Bureau, South Florida Water Management District
[2]Consultant

South Florida is home to about 8.1 million people. The region is characterized by low relief, flat topography and hydrology driven by a delicate balance between rainfall and evapotranspiration, high surface-water and groundwater interaction, presence of urbanized areas along the coast, significant agricultural areas and a protected natural area - the Everglades. The water resources of this complex region is managed by the South Florida Water Management District (District). The District operates this system for flood control, water supply, water quality treatment and ecosystem restoration. The hydrology of this region is driven mainly by rainfall and evapotranspiration. Thus, knowledge of changes in future climate parameters that affect these hydrologic components is critical for (i) projecting water resources availability, (ii) identifying water management system vulnerability and (iii) designing adaptation measures. One way of characterizing rainfall is the development of depth-duration-frequency curves.

Rainfall depth-duration-frequency curves are used for planning environmental and stormwater management projects. NOAA Atlas 14 volume 9 contains estimates of precipitation depth-duration-frequency (DDF) curves along with associated 90% confidence intervals and annual maxima series (AMS) at 242 weather stations in the state of Florida. The DDF curves were developed by NOAA using all precipitation data available at each weather station for the period between 1840 and 2012. The US Bureau of Reclamation has developed bias-corrected and statistically-downscaled climate projections from the World Climate Research Programme (WCRP) Coupled Model Intercomparison Project (CMIP) phase 5 (CMIP5), which can serve as a basis for future DDF curve development. In order to correct for biases in modeled precipitation extremes, the Equidistant Quantile Mapping method (EQM) is employed. Due to the need for using similar lengths for current and future periods in EQM, there is a need to fit DDF curves fit to NOAA Atlas 14 AMS data for the current baseline period defined as 40-50 years centered at approximately the year 1970. Methods for fitting consistent DDF curves to NOAA Atlas 14 and USBR's "Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections" precipitation data for current baseline and future periods of interest are presented and contrasted. Bias-corrected DDF curves for future periods of interest based on EQM will be presented as well. The developed future rainfall depth-duration-frequency curves for South Florida will enable engineers and planners in quantifying future water availability for environmental and water resources projects.

BIO: Tibebe Dessalegne is a Lead Engineer within Hydrology and Hydraulics Bureau at the South Florida Water Management District. He holds a Ph.D. in Civil Engineering from SIU. He holds a professional Engineering license from the state of Florida. In addition, he is a registered Professional Hydrologist and is a Diplomate Water Resources Engineer

Contact Information: Dr. Tibebe Dessalegne, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406, Email: tdessale@sfwmd.gov

TAYLOR SLOUGH GROUNDWATER DISCHARGE SIMULATION USING SUTRA

Shimelis Behailu Dessu *and René M. Price*
Florida International University, Miami, FL, USA

In the southern Everglades, coastal groundwater discharge is driven by hydraulic head and density differentials among the fresh, brackish and salt water interfaces. The saturated-unsaturated transport model (SUTRA) is used to simulate variable density groundwater flow and solute transport in the Taylor Slough region of Everglades National Park. A 2D vertical profile of the slough was established from the L-31W levee in the north to Florida Bay in the south. Topography and Biscayne aquifer characteristics were input to simulate the hydrogeologic conditions of Taylor Slough. Upstream freshwater inputs, rainfall, evapotranspiration and water level from monitoring wells along the transect were included in the model. The model was run from 2002 to 2014 on a monthly time step. Results suggest that in the absence of significant hydraulic head difference, the density variation at the salt water mixing zone is a major factor in coastal groundwater discharge at the salt water mixing. The modeling endeavor will help to better understand the role of variable density in coastal groundwater discharge in a region of low hydraulic head.

BIO: Dr. Dessu is a post-doctoral associate more than 10 years of experience in hydrological modeling, water resources planning and management, and has been participating on a number of Everglades restoration projects.

Contact Information: Dr. Shimelis Dessu, Southeast Environmental Research, 11200 SW 8th St., AHC5 -#364, Miami, FL 33199, Phone: 305-401-5898, Email: sbehailu@gmail.com

MOLECULAR CHARACTERIZATION OF ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE FISH COMMUNITY

Edgardo Díaz-Ferguson[1]*, John Galvez*[2]*, Greg Moyer*[3]*, Allan Brown*[4] *& Jeff Herod*[5]

[1]Institute of Scientific Investigation and High Technology Services (INDICASAT-AIP), Building City of Knowledge, Clayton, Panama
[2]U.S. Fish & Wildlife Service, Peninsular Florida Fisheries Office (FWCO), Vero Beach, FL
[3]School of Fisheries, Department of Biology, University of Mansfield, Mansfield, PA
[4]U.S. Fish & Wildlife Service, Fish and Aquatic Conservation, Atlanta, GA
[5]U.S. Fish & Wildlife Service, Branch of Consultation and Habitat Conservation Planning Headquarters, Falls Church, VA

The Arthur R. Marshall Loxahatchee National Wildlife Refuge fish community was described based on results of boat electrofishing. Surveys were conducted at 102 sites located in canals of the Refuge from October 2011 to October 2012. 15,440 individuals from 34 fish species were collected (29 native and 5 introduced). Species identification was based initially on morphological traits. The introduced species were Brown Hoplo, Bullseye snakehead, Mayan cichlid, "Sailfin catfish", and "Tilapia". Several of these species may actually have multiple cryptic species or hybrids which we counted as a single species (i.e., "Sailfin catfish" and "Tilapia" are probably multiple species each). Thus, species identifications were then challenged using barcode (molecular characterization base on the sequence composition of COI mitochondrial DNA gene amplified PCR using universal FishF2 and FishR2 primers). A total of 106 tissue samples were analyzed. One sample failed to PCR amplification even after repeated attempts and DNA re-extraction. Thirty one of 105 (30%) analyzed sequences were verified by Barcode of Life Data System (BOLD) the remaining was only referenced through GENEBANK. Sequence lengths were approximately 500 nt long. No insertions, deletions or stop codons were observed in any sequence. While BOLD categorized the remaining 74 sequences as invalidated, they had a high (often >95%) sequence similarity to the field (morphological) species identification. We believe this technique is an important tool to consider for documenting the fish species present in National Wildlife Refuge waters.

<u>BIO</u>*:* Edgardo Díaz-Ferguson has an *MSc* in Ecology and a *PhD* in Genetics from the University of Cadiz, Spain and postdoctoral experiences at UF, UGA and Auburn University. Currently he's an adjunct Faculty of the Institute of Scientific Research and High Technology Services where he focusses his research in genetic connectivity, barcoding and environmental DNA.

<u>Contact Information</u>: Dr. Edgardo Diaz-Ferguson, Institute of Scientific Investigation and High Technology Services (INDICASAT-AIP), Clayton, Panama, Email: diazedgardo7213@gmail.com

SOIL ACCRUAL AND PHOSPHORUS RETENTION IN A FLOW-WAY DOMINATED BY SUBMERGED AQUATIC VEGETATION WITHIN AN EVERGLADES STORMWATER TREATMENT AREA: A LONGITUDINAL STUDY

Forrest E. Dierberg[1]*, Thomas A. DeBusk*[1]*, Michelle Kharbanda*[1]*, Janelle Potts*[1]*, Kevin Grace*[1]*, Nichole Larson*[1]*, Nancy Chan*[1]*, Dawn Sierer Finn*[1]*, Mike Jerald*[1]*, Scott D. Jackson*[1]*, and Delia Ivanoff*[2]

[1]DB Environmental, Inc., Rockledge, FL, USA

[2]South Florida Water Management District, West Palm Beach, FL, USA

Five large (2000-6600 ha) treatment wetlands, known as stormwater treatment areas (STAs), have been constructed for removal of phosphorus (P) from drainage waters prior to release into the Everglades. To assess the efficacy and longevity of P removal in a predominantly SAV-dominated flow-way (Cell 3) within one of the STAs (STA-2), we performed comprehensive field sampling of porewaters and soils, and laboratory P soil release studies, in September 2005, January 2010, and August 2016.

Analysis of the 0-4 cm surface soil indicated an increase in TP content from 2005 to 2010, from 917 to 1090 mg kg^{-1} in the front half, and 652 to 925 mg kg^{-1} in the back half of the flow-way. However, 2016 sampling indicates that surface (0-4 cm) soil TP concentrations were comparable (1096 mg kg^{-1} and 997 mg kg^{-1} in the front and back halves of the cell, respectively), 6.6 years later, suggesting a leveling off of P concentrations since 2010. Higher TP concentrations over time at the 4-10 cm and 10-16 cm soil depths indicated burial or downward diffusion of P in both regions of the cell. Steeper inflow-to-outflow longitudinal gradients were observed for extractable SRP fractions than for soil TP in 0-4 cm soil, i.e. outflow region SRP concentrations were lower than inflow region concentrations by 33% for 1 M HCl and 66-93% for 0.5 M $NaHCO_3$ extractions. There was no observable temporal trend in extractable SRP concentrations except for the lower 0.5 M $NaHCO_3$ extractable SRP concentration in inflow region soil in 2016 compared to the earlier years.

The porewater SRP concentrations at 0-4 cm soil depth, while averaging higher in the inflow (84 µg L^{-1}) than outflow (11 µg L^{-1}) regions of the cell from 2005-2016, decreased significantly within the inflow region in 2016 (32 µg L^{-1}) compared to concentrations obtained in 2005 (113 µg L^{-1}) and 2010 (108 µg L^{-1}). This temporal trend at the inflow half of the cell was also observed for the SRP released from anoxic soil slurries incubated in the lab and the soil 0.5 M $NaHCO_3$-extractable SRP (both at 0-4 cm soil depth).

Soil accrual rates calculated from total accrued soil depth were greater at the inflow (1.26 cm yr^{-1}) than outflow (0.96 cm yr^{-1}) regions from June 1999 (date of first flooding) to August 2016. Due to the lower soil accretion rate, lower bulk densities, and lower TP concentrations at the outflow region, P accretion rates are lower by a factor of five compared to the average inflow deposition rate of 2.00 g P $m^{-2}yr^{-1}$.

The relatively low levels of porewater and extractable SRP concentrations in soils within the back half of the flow-way, as well as low SRP release during anoxic lab incubations, suggests that even after 17 years of operation, the SAV-dominated wetland (Cell 3) is capable of effective long-term P removal from runoff at present loading rates (1.26 g P $m^{-2}yr^{-1}$). The longevity of P removal in this cell is more likely to be constrained by particle deposition and detritus build-up than P saturation in the accrued soil layer.

BIO: Dr. Dierberg has studied P removal and control technologies in wetlands for more than 40 years. His involvement with the STAs began in the 1990s with the prototype STA (ENRP), and has subsequently published 16 peer-reviewed articles on P and sulfur hydrobiogeochemistry in the STAs.

Contact Information: Forrest E. Dierberg, DB Environmental, Inc., 365 Gus Hipp Blvd., Rockledge, FL 32955, USA, Phone: 321-639-4896, Fax: 321-631-3169, Email: woody@dbenv.com

EVERGLADES PEAT LOSS

Thomas W. Dreschel
South Florida Water Management District, West Palm Beach, FL, USA

Historical, spatially referenced data can provide an opportunity, to not only describe past conditions, but inform changes that have occurred through time to the present. With the aid of geographic information systems (GIS) and access to predrainage, early post-drainage, and other historical surveys, data sets and descriptions, as well as, current spatial data, we created topographic maps and analyzed landscape-scale changes in topography and peat volumes over a century of change. This allowed us to quantify subsidence and CO_2 evolution at the regional scale by calculating the changes in peat volume.

We determined the amount of peat lost from the Everglades using these data and spatial analysis tools. The spatially referenced data used were peat surface data created for a Natural System Regional Simulation Model (NSRSM) using historical land surveys, data gathered within the Everglades for the South Florida Topography Project, a south Florida bedrock map created mid-20th century, land surveys made in the Everglades Agricultural Area, tree island topographic surveys from 1976 and 2009 and data from the USEPA RE-MAP program.

These data sets have allowed us to evaluate change in volume, mass and carbon on a whole-system, regional, down to a single tree island scale. The analyses will be discussed in relation to the impact on restoration of the Everglades and the effect on the regional and global carbon cycles.

BIO: Dr. Dreschel is a Section Leader involved in ecological monitoring and research. His unit is responsible for conducting research regarding Everglades landscape patterning, tree islands and Florida Bay. He has spent over a decade involved in Everglades restoration research and has coauthored a book on the historical Everglades.

Contact Information: Thomas W. Dreschel, South Florida Water Management District, Everglades Systems Assessment Section, 3301 Gun Club Road, MSC 4352, West Palm Beach, FL 33406, USA, Phone: 561-682-6686, Email: tdresche@sfwmd.gov

THE GHOST TREE ISLANDS OF EVERGLADES WATER CONSERVATION AREA 2A: TRACING A HISTORY OF CHANGE

Thomas W. Dreschel
South Florida Water Management District, West Palm Beach, FL, USA

The majority of the tree islands in Water Conservation Area 2A are now considered to be “ghost tree islands” due to the fact that the patterning still exists but what once were woody tree islands are now primarily large sawgrass ridges. These tree islands experienced greater impacts than those in the rest of the existing Everglades due to the extreme drying events of the late 1800s through the early 1900s, followed by high water levels enabled by the Central & Southern Florida Project.

One island, termed “Dineen Island” has historical information available that gives some insight into what has occurred, at least in recent history, to these tree islands. Once a distinct island within the Everglades, it is now a small stand of exotic and native trees and shrubs surrounded by a large area of sawgrass. Surveys conducted in 1973 and 2009 as well as historical notes from the Everglades scientist, J. Walter Dineen provide insight into what has happened and what is still happening to this and most other islands of WCA-2A. Aerial photos taken each decade from the 1940s through the 2000s also aid in demonstrating this process. It appears from the 1940 image that the tree island had been degraded but still hosted a significant stand of trees.

In order to evaluate the changes that have occurred, we utilized the surveys to determine the change in topography between 1973 and 2009. Soil cores collected in 2009 were sectioned by depth and analyzed for bulk density, phosphorus, nitrogen, carbon and organic matter. These cores represent a “peek into the past” as the changes in peat are accomplished over an extended period of time. The estimates of subsidence between 1973 and 2009 indicate that as much as 8,000 metric tons of peat, 3,500 metric tons of carbon, 2.3 metric tons of phosphorus and 234 metric tons of nitrogen may have been lost from this single island over the 36-year period. Field notes from J. Walter Dineen provide a description of the changes in the region occurring between 1953 and 1973. The presentation will describe these changes and a proposed technique to try and mitigate these changes.

BIO: Dr. Dreschel is a Section Leader involved in ecological monitoring and research. His unit is responsible for conducting research regarding Everglades landscape patterning, tree islands and Florida Bay. He has spent over a decade involved in Everglades research and has coauthored a book on the historical Everglades.

Contact Information: Thomas W. Dreschel, South Florida Water Management District, Everglades Systems Assessment Section, 3301 Gun Club Road, MSC 4352, West Palm Beach, FL 33406, USA, Phone: 561-682-6686, Email: tdresche@sfwmd.gov

PHOSPHOROUS SPECIATION USING P31 NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY IN ORDER TO TRACE PHOSPHOROUS SOURCES AND MOVEMENT IN THE C51 BASIN AND NORTHERN EVERGLADES

Bobby G. Duersch *and J. William Louda*
Department of Chemistry and Biochemistry, Florida Atlantic University, Boca Raton, FL USA

Phosphorus (P) can be found in most everything, such as DNA/RNA, sediment/rocks (apatites), water, and many other anthropogenic sources. Excessive amounts of horse manure in the C51 basin can lead to high soil P concentrations and a high amount of P leaching into water sources which could lead to eutrophic conditions and large algal blooms. Through nutrient analyses and phosphorus (P) speciation studies we can in turn determine how P moves through the ecosystems that feed the Everglades, Lake Worth Lagoon and adjacent water bodies.

This research includes nutrient (P, N, Fe etc.) analyses of horse manure and bedding and the water and soils from and adjacent to canals that feed into the Palm Beach Canal (C51) as well as the Stormwater Treatment Areas (STAs) 1E and 1W. Not only will the various forms of phosphorus (DIP, DOP, POP, TP, and SRP) be quantified through a modified Hedley Fractionation but the use of ^{31}P-NMR (Nuclear Magnetic Resonance) will entail the speciation (free ortho-phosphate, pyro-phosphate, poly phosphates, esters etc.). ICP-OES (Inductively Coupled Plasma- Optical Emission Spectrometry) will be used to determine total concentration for a variety of elements, notably metals. An in-depth study of the effect of metal cations (paramagnetic, diamagnetic, ferromagnetic) on P31-NMR data is currently underway. Novel metal removal procedures for the cleanup of phosphorous containing samples without affecting the native P forms are planned. Additionally, phytoplankton and microphytobenthos will be collected from aquatic ecosystems and the communities' assessed using pigment based chemotaxonomy using extracted photosynthetic and accessory pigments. Hopefully, the results of this dissertation research will aid in having stronger pollution prevention legislation enacted for restoring and protecting the Everglades. This may include locally monitored Total Maximum Daily Loads (TMDLs), new Best Management Practices (BMPs) and the-like.

Acknowledgement: This research is being funded by an award to the senior author (BD) from the Everglades Foundation and that support is gratefully appreciated.

BIO: Bobby Duersch is in his third year on a PhD track at the Department of Chemistry and Biochemistry at Florida Atlantic University. Recently, he was just awarded a scholarship of $10,000 from the Everglades Foundation to be used in implementing plans in restoring the Everglades.

Contact Information: Bobby Duersch, Dr. J William Research Group, 777 Glades Rd, Boca Raton, FL 33431, USA, Phone: 435-764-4254, Email: bduersch2014@fau.edu

CONSIDERATIONS FOR CONTROLLING WILLOW INVASIONS OF MARSHES

Michael Duever
Natural Ecosystems, Naples, FL, USA

For many years we've watched willows, *Salix caroliniana*, invade marshes in the Corkscrew Swamp watershed in southwest Florida. I have always considered this a natural successional process in the absence of fire, but others have been unhappy about this invasion for a variety of reasons. In the last few years, I have become aware of efforts to control this rapidly expanding willow invasion of marshes, some of the ways people are trying to eliminate them, and the plant communities that were developing as a result of these efforts. I know a number of sites in SW Florida have been trying to deal with the problem over the last 10 years, and that similar efforts are occurring on the St. Johns River floodplain and Paine's Prairie Preserve State Park near Gainesville, Florida. Also, willow is considered an invasive exotic in Australia, where there have been some intensive efforts to control it.

When I asked a number of land managers in southwest Florida what their goal was when they were attempting to control willows, the answer was that they wanted to kill the willows with the assumption that this would bring back the marshes. And while I talked with some people in other parts of Florida who were evaluating the results of their control efforts, there were no monitoring efforts in SW Florida to quantitatively determine what vegetation occupied the sites after the willows were killed. So several of us have been trying to collect some data to address this question, and what we've been coming up with to date has not been encouraging.

Mechanical clearing of willows, particularly with follow-up spot herbiciding of resprouting willows and other nuisance vegetation such as southern cattail, *Typha domingensis*, and Peruvian primrosewillow, *Ludwigia peruviana*, has been showing promise for restoring marshes that can support fire. Unfortunately, willow usually occupies among the deepest and longest inundated vegetated sites, and they often grow on deep organic soils, which provide a very unstable substrate for the use of heavy equipment. To date, the most frequent method used to kill willows has been aerial herbicide spraying because of the difficulty of accessing and getting around on these sites. However, the use of aerial herbicide spraying to control willows appears to be doing irreversible damage to the species needed to reestablish fire in these wetlands. At this point, it seems we need a much better understanding of what aerial herbicide spraying can and can't do to restore a species composition that will support fire in the "restored" plant communities.

However, even if we are able to restore the original marshes, all too often there is an inability to successfully apply fire to keep the deceased willows from just coming back. At some sites, it might be more reasonable to allow succession to proceed by not killing the willows, and possibly enhancing the establishment of native forested wetland species to expedite succession to a forested community.

I've committed to pulling together everyone I can entice to a willow control workshop this coming summer, and hopefully this will give us a better idea of where willow control science is today.

BIO: Mike Duever has been conducting research on wetland ecology for over 40 years. Much of his work has been focused on South Florida, but projects in many other parts of the United States has broadened his perspective on how these ecosystem work and what can significantly impact them.

Contact Information: Michael Duever, Natural Ecosystems, 985 Sanctuary Rd., Naples, FL 34120, USA, Phone: 239-304-1847,
Email: mikeduever@naples.net

INVASIVE EXOTIC SPECIES IN THE NORTHERN EVERGLADES: A REGIONAL PERSPECTIVE

Rebekah Gibble and ***Andrew Eastwick***
U.S. Fish and Wildlife Service, Boynton Beach, FL USA

The 144,000 acre, A.R.M. Loxahatchee National Wildlife Refuge, comprised mostly of wetland marsh habitats is what remains of the original, once vast, northern everglades. Known for its large expanse of tree islands, wet prairies, saw grass marsh, and sloughs and ecological importance for wildlife such as wading birds and alligators; the refuge faces the significant challenge of protecting marsh habitats and ecology from the invasion of numerous highly destructive non-native pests.

The interior marsh of the refuge, which is owned by the State of Florida but managed by the U.S. Fish and Wildlife Service under a 50 year license agreement, plays a large and unique role in the management of invasive species within the greater Everglades ecosystem. Due, in part, to the location of the refuge and factors such as the urban interface, the refuge is a source of some invasive species to adjacent areas and in other cases the Refuge is on the forefront for invasions and a stronghold for prevention of further expansion, such as for Burmese pythons and Nile monitors.

For example, dense and widespread *Lygodium microphyllum* in the refuge is a major threat to refuge ecology, and is also a threat to adjacent lands due to the abundance and ease of spore distribution of *Lygodium* in the refuge. *Lygodium*, gained a foothold in the region first in the northern Everglades, due to the area's proximity from the initial naturalized infestations of the east coast, prevailing wind patterns, and the presence of preferred vertical climbing structures (tree islands) for the exotic plant to dominate. Once *Lygodium* reached the ideal habitats of the refuge, the species thrived without adequate tools or resources to control it and has grown to catastrophic densities and is now a threat to the entire Everglades and beyond.

In contrast, Loxahatchee is on the front of expanding populations of other invasive species such as Burmese pythons, Nile monitors, and the laurel wilt pathogen. As a result of the refuge's inherent conservation value, ideal habitats for many aquatic invasive species, and location within the landscape, control of the worst invasive species is a priority for both USFWS and partners.

The vision for Loxahatchee Refuge includes use of an adaptive management approach and promotes gaining and disseminating scientific knowledge through supporting research and monitoring. In conjunction with many federal, state and local government agencies, universities, non-governmental organizations and the public, the refuge is cooperatively spearheading efforts to address research and long term management of nonnative invasive species, such as *Lygodium*. Examination of optimal chemical control technologies, ecological and cost effective follow-up treatment intervals, prescribed fire roles, and biological control development are among a few of the coordinated efforts the refuge and its partners use to produce the necessary tactics in the fight against invasive species. In one such study, aerial treatment of dense *Lygodium* on tree islands has been found to be an effective method for controlling *Lygodium* and allowing for native species recovery for up to one year in the absence of typical follow-up ground treatment. These results, and others, will be discussed in more detail.

BIO: Andrew Eastwick is a wildlife biologist at the Arthur R. Marshall Loxahatchee National Wildlife Refuge and has experience planning, designing, and implementing everglades invasive species management projects.

Contact Information: Andrew Eastwick, U.S. Fish and Wildlife Service, 10216 Lee Road, Boynton Beach, FL, USA 33473,
Phone: 561-735-6023, Email: Andrew_eastwick@fws.gov

HABITAT USE OF KEY RECREATIONAL FISH SPECIES IN ALTERED COASTAL EVERGLADES LAKES

*Jennifer Rehage, **Cody Eggenberger**, and Rolando Santos*
Florida International University, Miami, FL, USA

Recreational angling is a core socioeconomic activity in Florida, including the Everglades. These recreational fisheries depend on healthy fish populations, particularly in coastal areas, yet our understanding of what makes these fisheries sustainable is very limited. Particularly, our understanding of the effects of hydrological management and restoration actions on fishes lags well behind, especially for the larger recreational species (Snook, Tarpon, Redfish, and Spotted Seatrout). Thus, there is a pressing need for research that improves our understanding of how recreational fisheries are affected by current hydrological conditions, and how they will respond to restoration actions. For recreational fishes, one of the completely understudied areas is the coastal lakes in Florida Bay (Alligator Creek and McCormick Creek sub-estuaries). This area has experienced major changes since pre-drainage, including reductions in freshwater inflows and submerged aquatic vegetation, and increases in salinities, nutrients and phytoplankton. The effects of these changes on the role of these lakes as fish habitat are completely unknown. More importantly, ongoing restoration actions associated with the C111 Spreader Canal Western Project are increasing freshwater deliveries to the region, but we lack an understanding of what to expect in terms of effects on recreational fisheries. We seek to develop a predictive framework for the effects of hydrological variation, restoration, and climate change on recreational fisheries.

BIO: Cody Eggenberger is a Masters student at Florida International University in the Earth and Environment department in Dr. Jennifer Rehage's lab.

Contact Information: Cody Eggenberger, Florida International University, 11200 SW 8th Street ECS 119, Miami, FL 33199, Phone: 517-256-9105, Email:coeggenb@fiu.edu

RECOVER'S ROLE IN CERP IMPLEMENTATION

***Gretchen Ehlinger*[1]**, *Patrick Pitts*[2], *Andy LoSchiavo*[1], *and Patti Gorman*[3]
[1]US Army Corps of Engineers, Jacksonville, FL, USA
[2]US Fish and Wildlife Service, Vero Beach, FL USA
[3]South Florida Water Management District, West Palm Beach, FL., USA

Given the pace of the Comprehensive Everglades Restoration Plan (CERP) implementation in recent years, new knowledge gained on ecological drivers and stressors in the Everglades and estuaries, the past ten years of monitoring and the development of restoration planning tools, REstoration, COordination and VERification (RECOVER), the system-wide science team of CERP, has developed a Five Year Plan to determine the most crucial tasks to assist CERP implementation. As part of the RECOVER Five Year Plan, a process is being developed for the value added interaction between CERP project teams and RECOVER for the implementation phases (design, construction, operation and maintenance, and replacement/rehabilitation phases) of CERP projects. Specifying roles of RECOVER in these project phases will provide value to CERP by ensuring that new science is incorporated into project design, construction and operations, thus providing the adaptive management (AM) feedback loop and helping the project teams implement AM strategies. The new science is the knowledge gained from the monitoring and evaluation that RECOVER principal investigators have gathered and analyzed over the past ten years, as well as all relevant science being produced by the larger south Florida scientific community.

Establishing a process for incorporating new science, institutional science, RECOVER knowledge and information into the design and operations of CERP projects is vital for Everglades restoration because the science and monitoring data is continuously evolving, and there are often substantial time gaps from when the projects were in the planning phase to when design begins. A process is needed where RECOVER can interact with project teams and provide information to the teams as they move forward with actual design and construction. RECOVER will review and provide input to project-level monitoring plans, AM plans, and operation plans; obtain project-level data to include in the RECOVER System Status Reports (SSR); and also help the project teams update and identify AM opportunities in the design and operation of their project. This will also help Everglades managers know where and how RECOVER will provide information to the design, construction, and operation phases of CERP projects. These phases of CERP projects need RECOVER interaction to ensure the success of restoration projects.

BIO: Dr. Ehlinger is a senior biologist with more than 12 years of experience in Everglades restoration and system-wide science. She is a long-time manager for the RECOVER program which is primarily responsible for establishing a framework for measuring and interpreting system-wide responses to the Comprehensive Everglades Restoration Plan.

Contact Information: Gretchen Ehlinger, US Army Corps of Engineers, Jacksonville District, 701 San Marco Blvd., Jacksonville, FL, USA 32207, Phone: 904-232-1682, Email: gretchen.s.ehlinger@usace.army.mil

STRATEGIC COMMUNICATION AT THE SOUTH FLORIDA ECOSYSTEM RESTORATION TASK FORCE

Shannon Estenoz
South Florida Ecosystem Restoration Task Force, Davie, FL

Established by Congress in 1996, the South Florida Ecosystem Restoration Task Force (TF) consists of 14 members from including seven federal, two tribal, and five state and local government representatives. The TF coordinates the development of consistent policies, strategies, plans, programs, projects, activities, and priorities addressing the restoration, preservation, and protection of the South Florida ecosystem. The TF was required to develop a strategic plan for restoration and to report biennially on the progress of program. Over time the TF has improved this reporting requirement creating better tools to communicate progress. A key part of the biennial reporting process is the *System wide Indicators Report* which is design to communicate the status of the system "at a glance" through key indicators, as restoration is implemented. The tools of the TF to plan, report and communicate involve 3 tiers of information to supply the appropriate level of information needed by a given audience. These tools are updated regularly to keep up with ever technology and communication modes. The web-based version of the biennial report allows a reader to interact with progressively more detailed tiers of information.

BIO: Shannon Estenoz is the Director of Everglades Restoration Initiatives for the US Department of the Interior. Shannon is the Interior Secretary's representative in Florida on Everglades restoration issues. Shannon coordinates the Department's restoration efforts and is the Executive Director of the South Florida Ecosystem Restoration Task Force.

Contact Information: Shannon Estenoz, Office of Everglades Restoration Initiatives, 3321 College Avenue, Davie, FL 33314.
Phone: (954) 377-5967, Email: shannon_estenoz@ios.doi.gov

DIETARY FLEXIBILITY OF WOOD STORKS IN RESPONSE TO HUMAN-INDUCED RAPID ENVIRONMENTAL CHANGE IN SOUTH FLORIDA

***Betsy A. Evans*[1]**, *Jessica A. Klassen*[2], *and Dale E. Gawlik*[1]
[1]Florida Atlantic University, Boca Raton, FL, USA
[2]Texas A&M University, College Station, TX, USA

Wood Storks (*Mycteria americana*) serve as indicator species for wetland restoration due to their reliance on hydrologic processes that produce high quality foraging habitat and prey. As a result of human-induced rapid environmental change (HIREC), Wood Stork populations declined in South Florida during the mid to late 20th century. Human manipulation of the Everglades landscape resulted in a disruption of natural hydrologic conditions and the creation of novel anthropogenic water bodies. Despite the well-documented sensitivity of Wood Storks to changes in hydrologic conditions and human disturbance, storks are often seen foraging in anthropogenic water bodies along roadways, suggesting these novel habitats may provide adequate foraging habitat and prey. We sampled natural wetlands and anthropogenic water bodies (e.g., canals, wet and dry stormwater ponds, swales) to determine the aquatic fauna available for foraging storks. To determine Wood Stork prey selection, we compared the available fauna at random sites to stomach regurgitations (boluses) from nestling storks in five nesting colonies within both the natural marsh and urban landscapes. Historical studies show that exotic fish were absent in Wood Stork diets prior to the establishment of anthropogenic water bodies; however, we found exotic fish frequently in both anthropogenic water bodies and bolus samples. Furthermore, we found that Wood Storks selected prey that were more similar to larger-bodied fishes in anthropogenic water bodies than to the smaller fishes in the natural wetlands. In addition, we found that Wood Storks nesting in urban and natural marsh landscapes selected different species of larger-bodied prey. These dietary patterns suggest that Wood Storks have some form of behavioral plasticity in foraging habitat and prey species that may allow it to adapt to changes from HIREC.

<u>BIO</u>: Betsy Evans is a graduate student at Florida Atlantic University working towards a Ph.D. in Integrative Biology. Her research focuses on Wood Stork use of roadway corridors and their responses to human-induced rapid environmental change in South Florida.

<u>Contact Information</u>: Betsy Evans, Florida Atlantic University, 777 Glades Road, Boca Raton, FL, USA 33431, Phone: 561-297-0671, Email: bevans2014@fau.edu

ANURANS AS INDICATORS OF LANDSCAPE CHANGE IN SOUTHWEST FLORIDA

Edwin M. Everham III *, Maureen Bonness, John Cassani, David W. Ceilley, Jeremy Conrad, Dean A. Croshaw, Addison Cutler, Alexandra Elliott, Charles W. Gunnels IV, S. John Herman, Brent Jackson, Daniel Kern, Kayla Koszela, Amber Shaw, Morgane Sleeper, Dan Van Norman, Matthew Whitmer*

Amphibians can provide insight into long-term changes in our landscape, particularly changes in hydrology. The Southwest Florida Frog Monitoring Network is a citizen-science effort established in 2000 to collect long-term data on frog communities within the watersheds of Southwest Florida. Routes of 10-15 stops each are monitored monthly during the rainy season (June – September). Environmental data on wind, temperature, humidity, water level, and sky conditions are collected at each stop, as is information on habitat changes. Data on all frogs heard calling during a three minute period are recorded using a three-level intensity code. We report on the data from seventeen years of monitoring, from 23 routes with over 7600 sampling events. We explore changes in populations of individual species across the region, interactions among species, and site-specific changes that may be driven by landscape alteration. We calculated measures of biological diversity, community classification, and community ordination, as techniques for exploring the factors that explain the differences in frog communities among routes, sites, and over time. Changes in frog populations and communities may provide opportunities to detect the environmental implications of altered hydroperiods and landscape changes in our watershed, regional and global climate changes, and possibly the positive responses to restoration efforts.

Contact Information: Edwin Everham, Florida Gulf Coast University, Marine and Ecological Sciences, 10501 FGCU Blvd. S., Ft. Myers, FL 33965-6565, Phone: 239-590-7169, Email: eeverham@fgcu.edu

STATE OF LAKE TRAFFORD FOLLOWING RESTORATION DREDGING

Edwin M. Everham III *, Rod A. Braun, Mark Lucius, John A. Ferlita II, David W. Ceilley, Serge Thomas*

Lake Trafford is a shallow, subtropical lake with a surface area of about 600 ha and an average depth of 2 m; it is the largest freshwater lake south of Lake Okeechobee. It has been exposed to anthropogenic nutrient loading primarily from nearby agricultural lands and urban areas associated with the city of Immokalee. Excessive growth of *Hydrilla verticillata*, introduced in the 1960s, negatively impacted the lake. The lake bottom accumulated large amounts of decaying plant matter following herbicide treatments, which consequently released nutrients back into the water column. Pre-restoration Lake Trafford was therefore a phytoplankton dominated system with frequent algal blooms and fish kills. A restoration project involving hydraulic dredging of excess sediments and decaying vegetation from the bottom removed 4.8 million cubic meters. We report on the post-dredging lake dynamics, including macrophyte coverage resulting from natural recruitment and planting efforts, zooplankton dynamics, trends in water quality. In addition, the results of a recent study to develop a lake water and nutrient model that incorporates groundwater inputs are included. Continued monitoring will provide important insight into the post-dredging conditions in Lake Trafford and help guide management toward a fully-restored lake. Examining the impacts, and relative success, of restoration dredging in Lake Trafford will help guide management decision on similarly impacted lakes.

Contact Information: Edwin Everham, Florida Gulf Coast University, Marine and Ecological Sciences, 10501 FGCU Blvd. S., Ft. Myers, FL 33965-6565, Phone: 239-590-7169, Email: eeverham@fgcu.edu

HOW CAN WE USE ACTIVITY PATTERNS TO IMPROVE THE MANAGEMENT OF INVASIVE REPTILES?

***Bryan G. Falk*[1]**, *Amy A. Yackel Adams*[2], *and Robert N. Reed*[2]
[1]USGS, Everglades National Park, FL, USA
[2]USGS, Fort Collins Science Center, CO, USA

A major obstacle in the research and management of invasive reptiles is the long search time necessary to find individual animals. Long search times may be reduced if the conditions when the animals are active (and likely to be encountered) are well understood. Furthermore, land managers planning rapid-response actions for newly invasive species may want to use information about activity patterns from closely related taxa to inform their searches. Using a large dataset of 2607 observations of 19 snake species in the Florida Everglades, we: 1) identify the covariates of activity for invasive Burmese pythons, and 2) evaluate whether covariates of activity are most similar among closely related species. Our results show how knowledge of activity patterns can improve invasive-reptile management by increasing search efficiency and informing rapid-response decisions.

BIO: Dr. Falk is a research ecologist for the USGS Invasive Species Science Branch in Everglades National Park and is lead on multiple research projects on invasive reptiles.

Contact Information: Bryan Falk, USGS, Daniel Beard Center, Everglades National Park, 40001 SR 9336, Homestead, FL, USA 33034; Phone: 305-242-7820; Email: bfalk@usgs.gov

EFFECTS OF JUVENILE ALLIGATORS ON DRY-SEASON AQUATIC FAUNA CONCENTRATION

***Thomas J. Faughnan*[1] *and Dale E. Gawlik*[1]**
Florida Atlantic University, Boca Raton, FL, USA

Crocodilians are found within tropical climates worldwide where they often shape their wetland environment. The American alligator (*Alligator mississippiensis*), found throughout the Everglades, is one of 23 extant species of crocodilians. The excavation of ponds, construction of nest mounds, and creation of trails in wetlands create habitat for many organism, making adult alligators ecosystem engineers. Throughout the Everglades, concentration of aquatic fauna within topographical depressions is a key ecosystem function that provides aquatic predators, such as wading birds, with high quality foraging patches. Therefore, it is important to understand the mechanisms which create depressions in the otherwise homogenous landscape.

Juvenile alligators inhabit Everglades sloughs for much of the dry season to avoid antagonistic interactions with larger conspecifics, which seek refuge in deeper water such as canals. In part because of the difficulty of accessing the marsh during the dry season, the ecological role of these mid-sized alligators is poorly understood. We hypothesize that juvenile alligator movement is a mechanism for increasing slough microtopography, which leads to higher density concentrations of aquatic fauna during the dry season.

During the 2016 dry season, we conducted a pilot experiment, creating depressions within sloughs to mimic juvenile alligator use. An index of aquatic fauna density was measured within manipulated and unmanipulated plots. We found a significant ($p=0.01$) increase in aquatic fauna in manipulated plots ($\bar{x}=111.75$, SD =28.5) compared with unmanipulated plots ($\bar{x}=29$, SD=13.6) in our preliminary data. During the spring of 2017, we will continue to test this hypothesis. Additionally, we will conduct alligator surveys in order to map alligator presence, and investigate its correlation with local scale microtopography.

A more comprehensive understanding of the American alligator and how it relates to dry season fauna concentration will contribute to the recovery of wading birds in the Everglades and seasonally flooded wetlands worldwide.

BIO: Tom Faughnan is a graduate student at Florida Atlantic University working towards an M.S. is Environmental Science. He has worked in many ecosystems and is interested in applied conservation. His current research examines the link between juvenile alligators and the aquatic fauna concentration in the Everglades.

Contact Information: Tom Faughnan, Florida Atlantic University, 777 Glades Road, Boca Raton, FL, USA 33431, Phone: 561-297-0671, Email: tfaughnan@fau.edu

AN ANALYSIS, INTEGRATION AND SYNTHESIS FOR ENHANCING NUTRIENT REMOVAL BY STORMWATER TREATMENT AREAS FOR EVERGLADES RESTORATION

Larry E. Fink
Waterwise Consulting, LLC, Hollywood, FL, USA

The remnant, impounded Everglades is underhydrated and overnourished. The Everglades is nutrient-impaired with overt manifestations of eutrophication. The limiting nutrient is phosphorus. The phosphorus chemical species involved in phosphorus biogeochemical dynamics and kinetics are summed as total phosphorus (TP). To make up the water quantity shortfall, the Everglades is being hydrated with polluted water. The polluted water comes primarily from inadequately treated agricultural runoff and recaptured leachate from the Everglades Agricultural Area (EAA). The runoff and peat soil leachate is recaptured by networks of tertiary, secondary, and primary canals that were designed to drain water when water levels are high during the summer wet season and supply water when water levels are low in the winter dry season. Agricultural water supply shortfalls during the winter dry season are made up with polluted Lake Okeechobee releases. Both sources contain excess nutrients from ongoing and internal recycling sources. As a consequence of this water management expedient, the Everglades continues to experience eutrophication caused by rehydrating it with inadequately treated polluted water supplies and unremediated legacy sources of excess nutrients in hotspot deposits laid down in the pre-STA period. In response to the damage done by the untreated external nutrient load to the remnant impounded Everglades, engineered wetlands were constructed, known as Stormwater Treatment Areas (STAs), to capture and remove the nutrients from those EAA and Lake Okeechobee flows. The STAs were initially sized by assuming that the same nutrient settling, recycling and sequestration processes would occur by the same mechanisms at the same rates per unit area as were occurring along a well-studied nutrient gradient in Water Conservation Area 2A (WCA-2A) , even though WCA-2A was never reclaimed farmland capable of recycling legacy nutrients from its peat soil. This paper explores the restoration implications of recycling of nutrients by rooted macrophytes in STAs and unremediated Everglades hotspots, including STA time-to-saturation and Everglades time-to-recovery, neither of which were included in the design of the STAs or the Everglades restoration plans. This scoping-level analysis, integration and synthesis is carried out using a spreadsheet model of phosphorus recycling by rooted macrophytes based on empirical relationships calibrated with measurements made along the same well-studied nutrient gradient in WCA-2A. The results of this scoping-level exercise suggest both that the STAs are underdesigned to achieve the 10 ppb TP Water Quality Standard and that the failure to remediate Everglades hotspots will retard Everglades restoration from decades to centuries. This further suggests that harvesting of rooted macrophytes would enhance the performance of the former and accelerate the recovery of the latter. The biomass can be used as a feedstock for electric power co-generation and/or various biofuels to recover some or all of the cost of harvesting.

<u>BIO:</u> Mr. Fink is Owner and Principal of Waterwise Consulting, LLC, with 35+ years of experience planning, designing, managing, and documenting environmental protection and restoration projects nationally, regionally and locally. This includes understanding and solving water quality problems, e.g., the Everglades mercury problem as South Florida Mercury Science Program Inter-Agency Coordinator.

<u>Contact Information</u>: Larry E. Fink, Owner and Principal, Waterwise Consulting, LLC, 1601 S. Ocean Drive, Suite 406, Hollywood, FL, USA 33019; Phone: 954-266-9663; Email: larryfink@waterwiseconsulting.com

ENVIRONMENTAL DNA (EDNA) AND ENVIRONMENTAL RNA (ERNA) MARKERS FOR INVASIVE SPECIES DETECTION

***Joshua Finn*[1],** *Margaret Hunter*[2], *Daniel Heath*[1], *Hugh MacIsaac*[1]
[1]University of Windsor, Windsor, Ontario, Canada
[2]United States Geological Survey, Gainesville, FL, USA

Invasive species presence can be inferred from detection of environmental DNA (eDNA) in water samples. However, eDNA can be detected weeks after the species has departed or has been removed from the location and can be transported through the movement of nets, predators, and deceased animals. There is therefore uncertainty about when or if the species was actually present, which can hinder efforts to locate invasive species for removal and determination of invasion fronts. RNA provides a smaller time window of detection than DNA owing to its much quicker degradation, thus positive detection using environmental RNA (eRNA) indicates more recent presence of the target species in the sampling area. Detection of eRNA would suggest that a live animal traveled through the area, and may provide estimates of the maximum distance traveled from the sampling location. To determine the viability of eRNA as a tool for species detection, we compared eDNA and eRNA detection using markers developed for grass carp (*Ctenopharyngodon idella*). We explored the utility of eRNA by testing eRNA detection through time and as a function of grass carp density. Water samples for eRNA and eDNA detection were taken throughout experiments and for a one month period following removal of grass carp. Successful detection of environmental eRNA from grass carp could lead to expanded use of eRNA markers for other species and in turn help to improve temporal and spatial information on targeted invasive species. In combination with eDNA markers, the potential use of eRNA markers could improve decision making and management of invasive species by providing more specific information on the location of targeted invaders.

BIO: Joshua Finn is a master's candidate from the University of Windsor, Canada. He has completed a thesis on the effects of algal blooms on zooplankton in the Great Lakes during his undergraduate degree at the University of Windsor and is currently studying genetic markers and grass carp.

Contact Information: Joshua Finn, Great Lakes Institute for Environmental Research, University of Windsor, 401 Sunset Ave, Windsor, Ontario, N9B 3P4, Canada, Phone: 1-519-253-3000 Ext 4243, Email: finnj@uwindsor.ca

INTEGRATED LANDSCAPE TRENDS OF WATER DEPTH/FLOW, PHOSPHORUS & SULFATE, SOIL ACCRETION, AND VEGETATION UNDER FUTURE MANAGEMENT SCENARIOS INCLUDING CLIMATE CHANGE AND SEA LEVEL RISE

***H. Carl Fitz*[1], *Hilary Flower*[2], *and Mark Rains*[2]**
[1]EcoLandMod, Inc., Fort Pierce, FL, USA
[2]University of South Florida, Tampa, FL, USA

Over the past several years, a collaboration organized by Florida Atlantic University and several government agencies involved multi-stakeholder workshops to develop plausible scenarios of future climate change and sea level rise (SLR) in south Florida. As part of this effort, the South Florida Water Management Model (SFWMM) was run (by Obeysekera et al. of SFWMD) under a variety of such future scenarios. Daily flows through water control structures from those SFWMM runs drove the managed flows of the ELM, which explicitly integrates dynamic flux equations of hydrology, nutrients, plants, and soils. The 36-year Baseline future run assumed 2010 initial conditions, to which two future scenarios were compared: (a) a 10% decrease in precipitation, a 7% increase in potential ET, and a 50-cm rise in sea level and (b) a 10% increase in precipitation, a 7% increase in potential ET, and a 50-cm rise in sea level.

In general, the decreased rainfall scenario had ecologically-significant decreases in surface-water depths in the northern/central-Everglades freshwater marshes, reflected in several hydro-ecological metrics; the increased rainfall scenario had marginal increases in surface-water depths and related changes to hydro-ecological metrics in those freshwater marshes, largely due to adherence to current water management operational criteria.

Sea-level rise caused the oligohaline ecotone to move as much as 15 km inland, depending on location, with a nearly 25% increase in marine-influenced landscape area. Mangroves encroached the sawgrass marshes, increasing by ca. 70,000 ha under the decreased rain (plus 50 cm initial Sea Level Rise) scenario; the increased rain scenario (plus 50 cm initial Sea Level Rise) resulted in roughly similar increases in open water/slough habitats, with just a modest increase in mangrove habitats. Peat accretion often (depending on location) decreased in the marine-influenced landscape in both scenarios, compared to the Baseline scenario - largely due to the (uncertain) extent and timing of vegetation succession (and thus changing plant turnover).

Phosphorus and sulfate loads from the marine front exhibited increases in the marine-influenced areas, and the resulting dynamic interactions of phosphorus, salinity, and sulfate are one of the topics of research in the Florida Coastal Everglades LTER. See the Flower et al. GEER poster session for further information/discussion on this overall modeling program.

BIO: Dr. Fitz is CEO of EcoLandMod, Inc. In government and academia, he has worked for over 20 years in developing models to better understand Everglades ecosystem dynamics across landscape scales, to support improved management and restoration of the Everglades.

Contact Information: H. Carl Fitz, EcoLandMod, Inc. 1936 Harbortown Dr, Ft. Pierce, FL 34946 USA. Phone: 561-818-6421.
Email: carlfitz3@gmail.com. Web: http://www.ecolandmod.com

TECHNIQUES FOR INCLUDING EXTENSION IN RESEARCH AND REPORTING

***Pamela J. Fletcher*[1,2] *and Michael Spranger*[3]**

[1]University of Florida, Florida Research and Education Center, Davie, FL, USA
[2]NOAA, Atlantic Oceanographic and Meteorological Laboratory, Miami, FL, USA
[3]University of Florida, Family, Youth and Community Sciences, Gainesville, FL, USA

Extension education includes the sharing of science-based information and research with well-defined end-users and facilitating knowledge sharing among stakeholders. The concept of extension education began in 1800s in Europe and expanded to the United States in the 1860s with the establishment of the land grant system to foster education through formal and informal programs. With time, the concept evolved beyond economic and technical extension and a marine component of the land grant system called Sea Grant was established in 1966. Today, the combination of land and sea grant staff working in extension across the country consists of 8,000 community-based agents, 2,000 campus-based specialists facilitating and implementing programs in 2,900 county or regional offices (Peter, 2014). Extension supports research, education and outreach to enhance economic opportunities, knowledge sharing and science-based information to target audiences.

In South Florida, the University of Florida's Sea Grant College Program partnered with the National Oceanic and Atmospheric Administration to create a liaison position to build awareness of the Greater Everglades Ecosystem. The effort included project-based extension with a goal of improving the understanding of the South Florida ecosystem for informed decision making. Activities included science-based communications among researchers, decision-makers, and critical segments of the South Florida population in addition to facilitation of workshops to gather and synthesize information about the ecosystem. Products include *Tropical Connections: South Florida's marine environment* book, contributions to the development of the first integrated ecosystem assessment for the marine and coastal environment in South Florida, and completion of a formal needs assessment of marine resource manager needs for decision making for the Florida Reef Tract. The Sea Grant liaison position employed extension techniques such as the needs assessment and stakeholder engagement to develop these products. Extension's role in South Florida has enabled communication and coordination with the multitude of organizations and institutions involved in interdisciplinary ecosystem research and restoration management tied to the Greater Everglades Ecosystem.

The Sea Grant liaison position serves as a model for other extension positions within land grant institutions. The liaison has been a conduit for providing research from numerous opportunities linking the National Oceanic and Atmospheric Administration and the University of Florida's Institute for Food and Agricultural Sciences and the Florida Sea Grant College Program with other scientists, stakeholders and decision-makers to achieve the goal of improving the understanding of South Florida's ecosystem.

BIO: Dr. Pamela Fletcher has been a Sea Grant Laboratory Liaison since 2006. Her position is supported by several organizations (UF's Institute for Food and Agricultural Sciences Extension, the Sea Grant College Program, NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami. Her current efforts are focused on improving the understanding of marine ecosystems for informed decision making.

Contact Information: Pamela Fletcher, UF/Fort Lauderdale Research and Education Center, 3205 College Avenue, Fort Lauderdale, Florida, USA 33314, Phone: 954-577-6303, Email: fletchp@ufl.edu

CONSEQUENCES OF HYDROLOGY FOR REPRODUCTION BY SNAIL KITES: A 20-YEAR INVESTIGATION

Robert J. Fletcher, Jr.[1]*, Caroline L. Poli, Ellen P. Robertson*[1]*, and Brian Jeffery*[2]
[1]Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA
[2]Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL, USA

Understanding the role of variation in hydrology across the Greater Everglades Ecosystem is critical for habitat management, restoration activities, and for the recovery of imperiled species in the region. The Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is a highly endangered, wetland-dependent raptor confined to central and south Florida. There has been a long-standing interest in understanding how hydrology alters the demography of snail kites, yet because snail kites use a wide variety of wetland habitats, isolating impacts of hydrology has remained challenging. We couple 20 years (1996-2015) of nesting data of snail kites (n = 3264 nests) across their breeding geographic range with information on hydrology gleaned from gauge data at eight wetland sites (>135 nests/site). We advance the use of methods aimed at detecting non-linear effects (e.g., thresholds, tipping points, skewed distributions) to quantify the complexity of hydrologic effects on nesting snail kites across space and time, focusing on survival of snail kite nests. We find that stage, recession, and ascension have impacts on nest survival, with negative effects of recession and ascension, and negative effects when stage is relatively high or low. Importantly, the magnitude of these effects vary by wetland. Non-linear methods that attempt to identify thresholds or tipping points in effects provide guidance for wetland-specific targets for hydrology regarding kite nest survival. We discuss the implications of these results for the conservation and recovery of the species and Everglades restoration, along with potential mechanisms that may be driving these changes in nest survival.

Bio: Dr. Fletcher is an Associate Professor at the University of Florida. His research focuses on landscape ecology, population biology, and conservation. He leads the UF/USGS effort to monitor snail kites across Florida, providing information on population trends and demography, as well as site-specific information for management and conservation.

Contact Information: Robert Fletcher, Department of Wildlife Ecology and Conservation, University of Florida, 110 Newins-Ziegler Hall, Gainesville, FL 32611, USA, Phone: 352-846-0632, Email: robert.fletcher@ufl.edu

CAN THE EVERGLADES SURVIVE CLIMATE CHANGE? ENVISIONING THE EVERGLADES UNDER CLIMATE CHANGE AND SEA LEVEL RISE

Hilary Flower[1]*, Mark Rains*[1]*, and Carl Fitz*[3]
[1]University of South Florida, Tampa, FL, USA
[2]EcoLandMod, Inc, Fort Pierce, FL USA

The Comprehensive Everglades Restoration Plan can only succeed to the extent that it builds ecosystem resilience to future climate change and sea level rise, but these changes cannot yet be predicted with certainty. In this project we take plausible "book-end" climate scenarios for 2060 (warming of 1.5 C, sea level rise of 0.5 meters, and either an increase or decrease of rainfall by 10%) as input into the Everglades Landscape Model to simulate a large suite of ecosystem responses that might occur.

Due to climate changes*,* throughout large portions of the freshwater Everglades the decreased rainfall scenario (-RF) had ecologically significant decreases in water depths (due to water scarcity); whereas in the increased rainfall (+RF) scenario, water management generally maintained water levels that were only marginally deeper than the baseline scenario in select subregions. With higher sea levels*,* the "marine-influenced" subregion of the Everglades National Park migrated landward by spatially-varying distances, ranging from ~7 to ~15 km inland, dependent on location within the Taylor Slough to Shark River Slough regions.

In this marine-influenced subregion: water depth and salinities increased under both scenarios (relative to Base) along a topographic-influenced gradient , as the press of sea level moved the oligohaline isoline landward; phosphorus accumulation rate generally increased under both scenarios , due to higher phosphorus concentrations in marine sources; peat accretion rate tended to decrease due to interactions of changing habitat types, altered nutrient availability, and increased salinity - and thus some decreases in plant productivity/turnover averaged over decadal time scales; mangroves replaced sawgrass (and some other freshwater habitats), expanding in spatially-varying manner, with more mangrove encroachment under decreased rainfall scenario (and less freshwater flow from upstream); and open water replaced some sawgrass habitats, and to more limited extent, mangroves in proximity of existing open water, expanding in spatially-varying manner, with more open water expansion under increased rainfall scenario.

Scenarios-based modeling is a primary tool for decision-making under uncertainty, as a means of *what-if* analysis rather than prediction. A detailed view of plausible outcomes can inform strategies to build resilience and robustness into restoration efforts as we look ahead to 2060.

BIO: Dr. Flower is a postdoctoral scholar in Ecohydrology in the School of Geosciences at University of South Florida, Tampa.

Contact Information: Hilary Flower, School of Geosciences, NES 107, University of South Florida, 4202 E. Fowler Ave, Tampa, Florida, USA 33620; E-mail: hflower@mail.usf.edu

RAPID AND INTENSE PHOSPHATE DESORPTION KINETICS WHEN SALTWATER INTRUDES INTO CARBONATE ROCK

***Hilary Flower**[1], Mark Rains[1], David Lewis[1], Jia-Zhong Zhang[2], René Price[3]*
[1]University of South Florida, Tampa, FL, USA
[2]National Oceanic and Atmospheric Administration, Miami, FL USA
[3]Florida International University, Miami, FL USA

An important but often overlooked consequence of saltwater intrusion is the potential increase of groundwater phosphate concentrations due to saltwater-induced desorption of phosphorus. In this project we investigated carbonate bedrock with low phosphorus content and sought to answer two key questions: (1) in freshwater-seawater mixing zones, how much saltwater content is necessary to trigger seawater-induced phosphate desorption? And (2) what is the rate, peak intensity, and duration of seawater-induced desorption of phosphate?

To determine the proportion of saltwater that is sufficient to induce phosphorus desorption, the phosphorus sorption dynamics of two limestone rocks of different composition were investigated by simulating seawater intrusion over a wide range of mixing ratios between freshwater and saltwater. Both rocks exhibited a logarithmic loss of sorption efficiency in mixtures containing more than approximately 3 mM Cl^- concentration (100 mg Cl^-/L; about 0.5% saltwater). We infer that aquifer solids immersed in freshwater would undergo phosphorus desorption in response to the introduction of this minor amount of seawater. This Cl^- concentration is within the range designated as fresh water. Thus we conclude that increased phosphate availability from saltwater-induced desorption may occur at the ion exchange front, which is actually landward of the saltwater intrusion front as it is commonly defined. Sorption efficiency in our experiments continued to decline as salinity increased, until Cl^- concentration reached a second threshold of 50 or 200 mM (1,700 or 7,700 mg Cl^-/L), depending on the rock composition, particularly iron content. Further increase in salinity would produce little increase in groundwater phosphate concentration.

To investigate the rate and intensity of seawater-induced phosphorus desorption, we conducted column leaching experiments using two carbonate rock samples. We measured total sedimentary phosphorus and found both rocks to be very low in phosphorus. For each rock sample, we packed a glass column with coarse grains and alternated flow between freshwater and saltwater. Phosphate concentration was low in freshwater leachate, with a mean of 0.2 μM. With the first influx of saltwater, phosphate concentration increased rapidly to peaks of between 0.8 and 1.6 μM. The phosphate concentration began to diminish as saltwater continued to flow, but sustained desorption continued for over two hours. Our results indicate that an influx of saltwater triggers an immediate and intense pulse of phosphate desorption from carbonate rock with low phosphorus content.

We conclude that small changes in seawater contribution can result in large changes in phosphorus sorption dynamics. Our results have implications for phosphate availability in estuaries that receive mixing zone groundwater discharge.

BIO: Dr. Flower is a postdoctoral scholar in Ecohydrology in the School of Geosciences at University of South Florida, Tampa.

Contact Information: Hilary Flower, School of Geosciences, NES 107, University of South Florida, 4202 E. Fowler Ave, Tampa, Florida, USA 33620; E-mail: hflower@mail.usf.edu

DIEOFF DÉJÀ VU – THE LATE 1980'S SEAGRASS DIEOFF IN FLORIDA BAY LOOKED EERILY SIMILAR TO CURRENT EVENTS

James W. Fourqurean
Florida International University of Florida, Gainesville, FL, USA

In the autumn of 1987, fishing guides and concerned citizens began reporting massive death of *Thalassia testudinum*-dominated seagrass meadows in the shallow lakes south of Flamingo in western Florida Bay, Everglades National Park. What was initially assumed to be a severe occurrence of the often-witnessed dieback of leaves on seagrasses from shallow, seasonally-intertidal mudbanks exposed to very hot water in late summer, the dieback seemed to abate in winter 1987, but by late summer 1988, extensive, formerly lush *Thalassia*-domiated seagrass meadows died in place, leaving at least 4000 hectares completely denuded and another 23,000 hectares with large dead patches distributed throughout.

The dense *Thalassia* meadows died in place, with death of below-ground tissues preceding the death and eventual shedding of the green above-ground leaves. The dead leaves, forced by wind and tide, collected in huge wracks, often up to 50 cm deep, that smothered and killed additional seagrass meadows. In some areas, infrequent shoots survived the dieoff events, but these shoots generally had become disconnected from any living below-ground stems that had formerly connected the shoots within a seagrass plant. These survivors displayed aberrant branching patterns, and began to recolonize the now destabilized, bare mud bottom.

Importantly, the death of the seagrasses initially began during a period of very clear water, in fact it was so clear that few, if any, historical data on phytoplankton abundance had ever been collected within Florida Bay. However, coinciding with the breaking of a multi-year drought, phytoplankton blooms began to be recorded in Florida Bay in 1991. These blooms severely restricted the amount of light reaching the seagrasses on the bottom, which led to a light-limitation and loss of seagrasses in deeper water. Not just shoots that had survived the initial dieoff in areas hard-hit by the initial phenomenon succumbed to this "secondary dieoff", but seagrasses in regions that had escaped the initial dieoff episodes were also lost. In addition to the bloom-related seagrass loss, the blooms also proved fatal to much of Florida Bay's sponge community, leading to a lack of filtration capacity. Florida Bay then experienced a state-change, from a clear, seagrass-dominated system to a turbid, plankton-dominated system; this state change slowly relaxed in the 15 years following the beginning of the dieoff event in 1987.

Much research was conducted, by many laboratories, on the causes of the initial loss of seagrasses. And, the dieoff lead to both comprehensive monitoring in Florida Bay and huge public outcry about the stewardship of south Florida's coastal ecosystems. While early research centered on the possible role of plant pathogens in the dieoff, a consensus emerged that hypoxia and resulting sulfide toxicity led to the initial die-off episodes. Conditions that led to the hypoxic conditions – warm temperatures and especially hypersalinity, had been exacerbated by human watershed engineering during a time of drought.

In 2015, seagrasses began dying in the same locations, and with the same symptoms, as they did in 1987. This second die-off was also related to a warm, late autumn drought. History suggests that Florida Bay is in for another 25 years of change following the recent events.

BIO: Dr.Fourqurean is a professor of Biological Sciences and Director of the Marine Educational and Research Center in the Institute for Water and Environment at FIU. He has studied biogeochemistry and seagrass ecology in Florida Bay for 35 years and has extensive experience in coastal ecosystems around the world.

Contact Information: Jim Fourqurean, Department of Biological Sciences and the Marine Education and Research Center, InWE, Florida International University, OE148 11200 SW 8th St, Miami, FL, USA 33199, Phone: 305-348-4084, Email: jim.fourqurean@fiu.edu

LIGHT ATTENUATION IN ESTUARINE MANGROVE LAKES

***Thomas A. Frankovich*[1]**, *David T. Rudnick*[2] *and James W. Fourqurean*[1]
[1]Florida International University, Miami, FL, USA
[2]Everglades National Park, Homestead, FL, USA

Submerged aquatic vegetation (SAV) cover has declined in brackish lakes in the southern Everglades characterized by low water transparencies, emphasizing the need to evaluate the suitability of the aquatic medium for SAV growth and to identify the light attenuating components that contribute most to light attenuation. Underwater attenuation of downwards irradiance of photosynthetically active radiation (PAR) was determined over a three year period at 42 sites in shallow (< 2m depth) mangrove-surrounded lakes in two sub-estuaries in the coastal Everglades, Florida USA. Turbidity, chromophoric dissolved organic matter (CDOM), and phytoplankton chlorophyll a (chl a) were measured concurrently and their respective contributions to the light attenuation rate were estimated. Light transmission to the benthos relative to literature estimates of minimum requirements for SAV growth indicated that the underwater light environment was often unsuitable for SAV. Light attenuation rates (n = 417) corrected for solar elevation angles ranged from 0.16 m-1 to 9.83 m-1 with a mean of 1.73 m-1. High concentrations of CDOM with high specific light absorption contributed the most to light attenuation followed by turbidity and chl a. CDOM alone sufficiently reduces light transmission beyond the estimated limits for SAV growth, making it difficult for ecosystem managers to increase SAV abundance by management activities. Light limitation of SAV in these areas may be a persistent feature because of their proximity to CDOM source materials from the surrounding mangrove swamp. Increasing freshwater flow into these areas may dilute CDOM concentrations and improve the salinity and light climate for SAV communities.

BIO: Tom Frankovich is a research scientist focusing on water quality and submerged aquatic vegetation.

Contact Information: Tom Frankovich, Florida International University, Florida Bay Interagency Science Center, 98630 Overseas Highway, Key Largo, FL, USA 33037, Phone: 305-393-4636, Email: frankovich@virginia.edu

FLORIDA BAY ALGAL BLOOM DYNAMICS

Zachary Fratto*, Vicki McGee-Absten, Matt Patterson, Eric Thompson, Christopher Kavanagh and Michelle Tongue*
National Park Service, Homestead, FL USA

In September 2016, water quality in parts of central Florida Bay changed dramatically from its normal state of transparent, oligotrophic waters. Aircraft surveys and satellite images identified a large area of green water within several connected basins. Chlorophyll-*a* pigment concentrations, a proxy for phytoplankton biomass, were measured from water samples, and an extensive algal bloom was confirmed. Chlorophyll-*a* concentrations as much as sixty four times higher (64 micrograms/liter, µg/L) than clear water conditions (<1.0 µg/L) were measured. Phytoplankton productivity to this extent in Florida Bay waters is unusual and extreme. Consistent monitoring of the algal bloom by NPS staff during the following months revealed fluctuating levels of chlorophyll-*a* spatially and temporally. The residual carbon and nutrient flux from the *Thalassia* seagrass die-off, which occurred during the summer of 2015 in the same central basins of Florida Bay, are hypothesized to be the source of the algal bloom.

BIO: Zachary Fratto is a biological science technician with more than 13years of experience studying biologic and hydrologic systems, nine of them in Everglades National Park. He has extensive experience with fisheries, vegetation, and hydrologic processes. He has worked on more than 15 projects dedicated to preserving Everglades.

Contact Information: Zachary Fratto, National Park Service, 98630 Overseas Highway, Key Largo, FL USA 33037, Phone: 305-242-7896, Email: zachary_w_fratto@nps.gov

EFFECTS OF MERCURY EXPOSURE ON NEST SUCCESS IN GREAT EGRETS (*ARDEA ALBA*): THE ROLE OF PARENTAL CARE.

Ignacio A. Rodriguez-Jorquera[1,2], Nick Vitale[2], Sophia Orzechowski[2] and ***Peter Frederick[2]****.*

[1]Centro de Humedales Río Cruces, Valdivia Chile

[2]University of Florida, Gainesville FL, USA

Reproduction in birds is thought to be one of the most sensitive processes to be affected by mercury (Hg) exposure. Many mechanisms may be involved, including teratogenesis, endocrine disruption, and effects on parental care. Partitioning these effects has proved elusive in part because it has often been difficult to assess parental exposure and nestling exposure in the same nests. We used nondestructive microsampling of egg albumin to determine Hg concentrations as a measure of female parental exposure. We subsequently sampled the resultant chicks from those eggs at later stages using blood and feather tissue through fledging. Samples were taken from the 2nd laid egg (0-5 days, 102 eggs, 7 colonies) and subsequently from blood (≈ 35-45 days) and feathers (≈ 46-60 days) from the same individuals. No statistical differences were observed in Hg concentrations between coastal and inland colonies in any sampled matrix, and we found no correlation between Hg concentration in albumin and hatching success. This suggested embryonic death was not a primary mechanism by which Hg affected nest success. However, colony-averaged nest survival was negatively correlated with albumin Hg concentrations (GLM; p =0.0016), but not with Hg concentration in blood and feathers of chicks. Nests with average albumin Hg concentrations lower than 0.4 mg/kg had nest survival probabilities of 90-95%; in contrast, nests with average albumin Hg concentrations over 0.75 mg/kg had survival probabilities of 42-57%. This information collectively suggests that egg Hg concentrations are not affecting nest success through embryonic death. Instead, we suggest that Hg effects on nest success resulted primarily from deficits in parental behavior.

<u>BIO:</u> Dr. Frederick is a Research Professor in the Department of Wildlife Ecology and Conservation at UF. He is interested in the ecology of wetland vertebrates, effects of contamination, and restoration ecology. He has worked in the Everglades for over 30 years, and on wetland research projects in Asia, Africa, and South America. He has worked on mercury contamination issues in the southeastern U.S. for 20 years.

<u>Contact Information</u>: Peter Frederick, University of Florida, Department of Wildlife Ecology and Conservation, P.O. Box 110430, Gainesville FL 32611 USA. Ph. 352-846-0565. Email pfred@ufl.edu.

EFFECTS OF PRESCRIBED BURN ON PINE ROCKLAND SOIL HEALTH AND PLANT COMMUNITIES WITHIN FIU'S NATURE PRESERVE

Ariel Freidenreich[1], *Brittany Harris*[1], *Pushpa Soti*[2], *Eric Betancourt*[1], *Mariana Santos Reis*[3], *Shagufta Gaffar*[1], *and Krish Jayachandran*[1]

[1]Florida International University, Miami, FL, USA
[2]University of Texas Rio Grande Valley, Edinburg, TX, USA
[3]Federal University of ABC, Santo Andre, São Paulo, Brazil

Pine rockland is a dry, upland forest ecosystem that occurs only in South Florida and the Bahamas. While pine rockland historically occurred on limestone outcroppings throughout much of South Florida, only 2% of the historical extent remains, making it a globally imperiled ecosystem. South Florida pine rocklands exhibit the highest plant species richness of any habitat found in Florida, which includes many endemic and federally endangered species. Fire is a necessary component for sustaining the high herbaceous diversity in pine rocklands. Frequent fires maintain an open canopy, remove leaf-litter buildup, and prevent encroachment of hardwood species that outcompete with the shade-intolerant pine rockland plants. Reduced fire frequency has been shown to reduce plant diversity, which may impact other organisms that rely on these species. Florida International University has a small patch of preserved pine rockland habitat that was burned for the first time in March of 2016. We used this opportunity to determine the effects of fire for restoration of a degraded fire-dependent fragment that has historically not been properly managed with fire. We measured soil characteristics such as microbial content, CNP, pH, and OM%, as well as changes in the plant community and canopy cover. Measurements were taken 1 week pre burn, 1 week post burn, 4 weeks post burn, and 10 weeks post burn. Results of this study show significant increase in soil microbial communities between pre burn and post burn samples. Additionally, there was an increase in diversity of species within the herbaceous layer that correlated with canopy openness. However, many hardwood and invasive species emerged post fire along with pine rockland species. Prolonged absence of fire may have negatively impacted long-term health of the plant species in the pine rockland. It is possible that increased fire frequency may allow for recovery by exclusion of shade-tolerant species.

<u>BIO:</u> Ariel Freidenreich and Brittany Harris are both PhD students studying at Florida International University. Ariel is from the Earth and Environment Department with studies focused on agricultural soil health and its relation to crop growth. Brittany is from the Biology Department. Her studies focus on the relationships between pollinators and native plant species in the lower Florida Keys.

<u>Contact information:</u> Ariel Freidenreich, Florida International University, 11200 SW 8th St, Miami, FL 33199, Email: afrei006@fiu.edu

RESPONSE OF THE SAV COMMUNITY IN THE COASTAL MANGROVE ZONE OF FLORIDA BAY TO RECORD RAINFALL AND INCREASED FRESHWATER FLOW

Peter Frezza, *Michael Kline and Jerome J. Lorenz*
Audubon Florida, Everglades Science Center, Tavernier, FL, USA

Lack of adequate freshwater flow to the coastal mangrove estuaries of Florida Bay is believed to have suppressed the local submerged aquatic vegetation (SAV) community in these wetlands and led to declines in abundance of wildlife including waterfowl and game fish. An expected outcome of efforts to restore freshwater flow to the Everglades is a reversal in these trends. During 2015-16, three factors came into play that allowed for a unique insight into how the SAV community may respond with increasing flows through restoration: 1) Record regional rainfall which included the wettest November through January period since recordkeeping began in 1932, 2) Implementation of emergency operations by the SFWMD to move water out of WCA's to prevent flooding, 3) Modifications by the SFWMD to the C-111 canal system to allow for additional water flow to Florida Bay. As a result, dry season flow during 2015-16 into the Taylor Slough/panhandle region upstream of northeastern Florida Bay was nearly three times greater than average. Flow through Taylor Slough remained greater than average throughout the following wet season and into the dry season of 2016-17. This led to a sustained, anomalous period of salinity at or near freshwater conditions (<1psu) for over a year in the upstream coastal mangrove zone of Florida Bay.

Since 1996 we have been conducting routine SAV monitoring within the coastal mangrove zone of northeastern Florida Bay. Emphasis was placed on understanding how salinity and other physical parameters were affecting the abundance and diversity of the SAV community within this estuary. SAV surveying was conducted bi-monthly at six sites: Taylor River, East Creek, West Joe Bay, Joe Bay, Sunday Bay and Highway Creek. At each site, fixed stations were surveyed along a distinct salinity gradient, beginning in an upstream, interior dwarf mangrove zone and ending near or in Florida Bay. Physical water parameters were measured at each station on day of survey and were continuously measured (hourly) at the most upstream station at each site using dataloggers. SAV communities consisted of euryhaline seagrasses and brackish algal populations. Ordination techniques grouped SAV stations of similar mean annual salinity into two sub-groups, upstream and downstream. Upstream stations exhibited mean salinity ranging from 4-10psu and consisted of a mixed assemblage of fresh to brackish water species, dominated by *Chara hornemannii* and *Ruppia maritima*. Downstream stations exhibited mean salinity ranging from 11-21psu and were dominated by *Halodule wrightii*.

Prior to the onset of the substantial rain that began in the late wet season of 2015, the SAV community at upstream stations was suppressed, possibly in relation to drought conditions and prevalent hypersalinity in the coastal zone and Florida Bay during the prior year and a half. Mean SAV coverage at upstream stations during September 2015 was <3%. During the ensuing 14 month period, in concurrence with increased flows and reduced and stable salinity, SAV coverage increased by an average of 6% during each bi-monthly surveying event. By November 2016, coverage had increased by over 40%. Over the same time period, the *Halodule* community at downstream stations displayed relative stability to a moderate decrease of 20%, however this decline was not atypical based on our 20yr period of record. Indications are that a mimicking of more natural/historic flow conditions would be beneficial to this SAV community and that the plants respond relatively quickly to these changes.

BIO: Peter Frezza is the Research Manager for the Everglades Region for Audubon Florida's Everglades Science Center. He has been studying the ecosystems of the southern Everglades coastal mangrove zone for 18 years.

Contact Information: Peter Frezza, Audubon Florida, Everglades Science Center, Tavernier, FL, USA, Phone: 305-852-5318, Email: pfrezza@audubon.org

WATER QUALITY IMPLICATIONS OF HYDROLOGIC RESTORATION ALTERNATIVES IN THE FLORIDA EVERGLADES, USA: A PERIPHYTON PERSPECTIVE

Evelyn Gaiser[1], *Melodie Naja*[2], *Daniel Childers*[3], *and Carl Fitz*[1]
[1]Florida International University, Miami, FL, USA
[2]Everglades Foundation, Miami, FL USA
[3]Arizona State University, Phoenix, AZ, USA

As part of a larger project to synthesize Everglades research to guide restoration efforts, we examined water quality implications of five options for Everglades hydrologic restoration. Outputs from 36-year runs of the Everglades Landscape Model (ELM) showed that the amount of P in new water inputs will be largely controlled by P releases from stormwater treatment areas (STAs) and by the movement of legacy P. Because benthic microbial (periphyton) mats respond quickly to change in P and initiate an ecosystem-level eutrophication response cascade, we used ELM outputs (soil TP and water depth) to drive a periphyton response model (PERIMOD) that predicts abundance (biomass), quality (P content) and composition (edibility, an index of consumer presence).

We found that all restoration options caused the same direction of change in the three modeled periphyton variables across the entire ecosystem, but at smaller scales responses varied by region depending on water delivery scenarios and their effect on legacy P. The scenario of full-scale implementation of Comprehensive Everglades Restoration Plan (CERP) will have the greatest effect on periphyton biomass, due to increased water stage which reduces the concentration of calcium carbonate and the development of calcareous periphyton. These influences are greatest along the eastern and western edges of Shark River Slough (SRS) which will be significantly rehydrated: periphyton biomass is expected to drop by half of the existing baseline values. Biomass increases may be observed in the Water Conservation Areas.

Water quality changes resulting from restoration indicated by increasing periphyton TP concentrations will not be significant at the whole system scale, but notable decreases will occur in the WCAs. Some areas of increased periphyton TP may result from projected increases in water stage. These will be below those considered “baseline” (ie. 200 $\mu g\ g^{-1}$; equivalent to the legal water column TP concentration maximum) in most locations in the EPAs, although the full CERP scenario may cause the central SRS drainage and northeast corner to be slightly elevated. Periphyton edibility also responds positively to projected increases in water depth and the mobilization of legacy P, and is expected to increase significantly in all scenarios. Periphyton mats in unenriched areas of the Everglades are dominated by unpalatable cyanobacteria, but increased water depths in all scenarios will reduce mat biomass and cyanobacterial dominance, increasing the abundance and dominance of edible species of green algae and diatoms. These effects will be most noticable in the central SRS drainage, WCA-3A and 2-A, where edibility will increase from <5 to >20%. We expect this change in periphyton edibility to increase efficiency of trophic transfer and cascade through the food web from small aquatic consumers to wading birds.

BIO: Dr. Gaiser is Executive Director of the School of Environment, Arts and Society at Florida International University. She is also the lead Principal Investigator of the Florida Coastal Everglades Long Term Ecological Research program. She has extensive experience researching algae in lakes and wetlands, especially employing algae in reflections and projections of global environmental change.

Contact Information: Evelyn Gaiser, Southeast Environmental Research Center, Florida International University, Miami, FL, USA 33199, Phone: 305-348-6145, Email: gaisere@fiu.edu

STORMWATER TREATMENT AREA PERFORMANCE PREDICTION USING ARTIFICIAL NEURAL NETWORKS

William Gao[1]
[1]Suncoast Community High School, Riviera Beach, FL, USA

The Everglades Protection Area is the largest freshwater wetland ecosystem in the world, covering 810,000 hectares in South. The Everglades Stormwater Treatment Areas (STAs) were constructed as a component of the Everglades Restoration Act in southern Florida. These large-scale wetlands function to remove excess phosphorous from agricultural and urban runoff on water flowing through before it is discharged to the Everglades. Because of the nature of these facilities, creating methods of modeling and predicting the performance of the STA's became crucial. One such model was the Artificial Neural Networks (ANNs). ANNs is a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs. The objective of this project was to develop reliable ANNs for STA performance prediction by training the networks with previously recorded data over the past decade. Stormwater Treatment Area 2 (STA-2) was selected as a case study. Three ANNs were developed for three treatment cells 1, 2 and 3 of STA-2. These ANNs proved to be accurate as the predicted values provided by the ANN matched with the measured values closely. The high correlation coefficients and the small mean squared errors of the three ANNs' predicted values indicate that the ANNs were capable of making accurate predictions.

BIO**:** Mr. Gao is a junior high school student majored in MSE. He took an environmental course and learned about stormwater treatment areas. He self-studied artificial neural networks (ANNs). This was a perfect opportunity to connect these two topics that had captured his interest, predicting the STA performance using ANNs.

Contact Information: William Gao, 8134 Bautista Way, Palm Beach Gardens, FL 33418, Email: wlmgao2000@gmail.com

EVOLVING VIEWS OF FOOD-LIMITATION IN WADING BIRDS: DIFFERING IMPLICATIONS OF PREY AND FORAGING HABITAT AVAILABILITY

Dale E. Gawlik[1]*, Jessica A. Klassen*[1]*, and Peter C. Frederick*[2]
[1]Florida Atlantic University, Boca Raton, FL, USA
[2]University of Florida, Gainesville, FL, USA

Food-limitation is a common restriction for several wading bird populations. Effective management strategies for these populations must take into consideration the degree to which food abundance or foraging habitat affects sympatric species. These relationships may be best viewed as dynamic because species are adapting to different degrees to the rapid anthropogenic changes occurring to the South Florida landscape.

We determined prey selection for four wading bird species, and investigated the effects of prey and foraging habitat availability on the number of nests initiated by six wading bird species in the Florida Everglades. To determine prey selection, we compared food items recovered from Tricolored Heron (*Egretta tricolor*), Snowy Egret (*Egretta thula*), Little Blue Heron (*Egretta caerulea*), and Wood Stork (*Mycteria americana*) nestlings to aquatic prey availability across the Everglades landscape from 2012-2014.

We found that Tricolored Heron and Snowy Egret prey composition was statistically similar across years, with the majority of prey biomass coming from relatively large marsh fish. Little Blue Herons also consumed marsh fish, but they differed from the two herons in that they consumed higher proportions of grass shrimp and exotic fish species. Wood Stork prey composition differed from all small heron diets, composed of sunfish and exotic fish species. Numbers of small heron nests were driven more by local marsh fish densities, whereas numbers of Wood Stork nests were more influenced by the amount of foraging habitat that became available over the nesting season. Whereas small heron foraging may seem restricted by their specialization on marsh fishes, their short nesting cycles allows for the phenological flexibility to delay nesting within a dry season until foraging conditions are optimal. Conversely, Wood Storks with longer nesting cycles are more temporally constrained, but appear to have greater flexibility in prey species, foraging range, and foraging habitat. An increase in the proportion of exotic species in the diets of storks suggests that storks, more so than small herons, are exploiting and may be affected by the changing species composition of aquatic fauna in South Florida.

BIO: Dale Gawlik is Director of FAU's Environmental Science Program and Professor in the Department of Biology. He and his students have published over 65 papers, many focused on how hydrologic processes control wading bird populations in the Everglades.

Contact Information: Dale E. Gawlik, Environmental Science Program, Florida Atlantic University, Boca Raton, FL 33431 USA, Phone: 561-297-3333, Email:dgawlik@fau.edu.

DATA INTEGRATION & SYNTHESIS FRAMEWORK FOR UNDERSTANDING P CYCLING AND REDUCTION MECHANISMS IN STA FLOW-WAYS

***Stefan Gerber**[1], Kalindhi Larios[1], and Paul Julian[1]*
[1]University of Florida, Gainesville, FL, USA

Constructed wetlands including stormwater treatment areas (STAs), managed by the South Florida Water Management District, reduce nutrients in runoff waters to protect and restore the Everglades Protection Area. Long-term routine measurements of inflow and outflow nutrient concentrations and loads have been used to assess the performance of the STAs. Selective point in time assessment, combined with more intensive measurements such as transect along flow-ways studies can provide a qualitative picture how excess nutrients are removed within these wetlands and how the removal is affected by environmental factors. In order to better understand the importance of each of the manifold processes contributing to nutrient removal, there is a need to link these measurements with existing biogeochemical theory and knowledge.

Current biogeochemical models that capture our understanding of the processes are often rooted in conceptual model that depict the flow and reservoir of different tracers (e.g. carbon, nutrients, isotopes, etc.). These models aim to represent the processes in a mechanistic way, while portraying the fluxes with simple formulations that include first order or Michaelis-Menten type equations, which are then further modified by environmental factors (temperature, pH, Eh, etc.). Given the disparate data in form of measurements of stocks and flows, as well as environmental factors, these mechanistic-based models have the potential to integrate the data into a cohesive structure. More importantly the conjoint model-data analysis can help identify gaps in understanding of the processes occurring in the treatment wetlands as well as to help identify knowledge gaps and uncertainties.

Two main challenges to such data-model integration are the fact that many of the different processes act on very different timescales (from sub-daily to decades or more) and that biogeochemical transformations differ along the treatment flow-way. We will highlight approaches to these challenges with examples and data from STA flow-ways. The different timescales can be addressed by simplifying quasi-equilibria, where short-term processes may equilibrate quickly and induced noise does not persist. In contrast, long-term changes can be assumed to be constant when analyzing short term processes. This approach has been used previously and often implicitly. For example, it can be shown that the concept of C* star, the putative nutrient concentration in absence of external load, is a function of specific long-term processes (e.g. period of record of STA operation). The second challenge, the changes of biogeochemical processes along the flow-way require the inclusion of a spatial domain. Spiraling is a simple powerful concept that has been mainly used to address biogeochemistry in rivers and streams to describe interactions of nutrients with sediments. Applying this concept allows the linkage of spatial data and analyze performance, and to be able to qualitatively predict the gradient of accumulation and release of stored phosphorus in soils along the flow gradient of an STA.

BIO: Dr. Stefan Gerber is an Assistant Professor in the Soil and Water Sciences Department at University of Florida. His work encompasses development and analysis of biogeochemical data using models, including models that predict nutrient losses from terrestrial systems and help to understand how nutrient dynamics in water bodies help to understand the biogeochemistry of larger systems from watershed to global scale.

Contact Information: Stefan Gerber, Soil and Water Sciences Department, University of Florida, PO Box 110290 Gainesville, FL, USA 32611, Phone 352 294 3174. Email: sgerber@ufl.edu

DETECTING AND COUNTERING FISHERIES-INDUCED EVOLUTION USING MARINE PROTECTED AREAS

***Carissa L. Gervasi*[1]** *and Jennifer S. Rehage*[1]
[1]Florida International University, Miami, FL, USA

Fishing typically removes phenotypically desirable traits from populations, like large body size or aggressive personality. In this way, fishing acts as a genetic selection pressure on fish populations, and can induce rapid evolutionary change. This change is often contrary to and more significant than natural selection, and can decrease population fitness and lead to declines in abundance and consequently yield and profit to fisheries. Recent research has focused heavily on the concept of fishing-induced evolution. Studies have shown that it leads to earlier maturation, smaller size-at-age, changes in behavior, and overall decreases in genetic diversity in wild fish populations. Despite these negative impacts, little research to date has assessed how management can detect and counteract the effects of fishing-induced evolution in wild fish populations. The purpose of this research is use a combination of fieldwork and bio-economic modeling to assess how managers can use marine protected areas (MPAs) as a tool for tracking evolutionary change and counteracting its effects.

The first goal of this study will be to quantify differences in behavior (i.e. feeding hesitation, movement) and life-history parameters (i.e. size-at-age, maturation-at-age) between MPAs and fished areas for economically important fish species throughout South Florida to assess how fisheries-induced evolution affects the economics of the fisheries. We will choose 2-3 candidate fish species based on their abundance and distribution in protected and exploited areas throughout the Florida Keys and Florida Bay as well as their economic value. We will use baited underwater camera systems to assess fish behavior at multiple sites within MPAs and within exploited areas. We will also collect samples of fish across a broad size range to determine life-history metrics. We will then use a bio-economic modeling framework to assess how changes in the populations due to fisheries-induced evolution have affected yield and profit to the fisheries. We hypothesize that fish in exploited areas will have higher feeding hesitation and smaller size-at-age than fish in MPAs, leading to a significant decrease in yield and profit.

The second goal of this study will be to model biomass and composition in a fished area using the collected field results. The model will simulate different levels of spillover from a hypothetical MPA into the fished area to assess if the MPA can counteract the effects of fisheries-induced evolution by replacing lost individuals that were phenotypically superior. We hypothesize that there will be an ideal level of spillover that will maximize yield and profit to the fishery while ensuring health and sustainability of the population. This research will provide important information on a potential tool that managers can use to counteract the effects of fishing-induced evolution. The results of our model will also provide information on how MPAs can be created to maximize their effect and ensure sustainable harvest of economically important fish species in South Florida.

BIO: Carissa Gervasi is a PhD student at Florida International University working in Dr. Jennifer Rehage's coastal fish ecology lab. She received her MS degree in 2015 from the Virginia Institute of Marine Science, where she worked on fish population modeling and reproductive biology with Dr. Robert Latour.

Contact Information: Carissa Gervasi, Florida International University, 11200 SW 8th St. Miami FL, USA 33199, Phone: 305-348-0181, Email: cgerv002@fiu.edu

INTEGRATED WEED CONTROL

Lyn A Gettys
University of Florida FLREC, Davie, FL, USA

IPM (integrated pest management) is the strategy of using “all the tools in the toolbox” for control of invasive species. In this presentation I will outline the philosophy of IPM and discuss the four main types of management strategies that can be used in IPM programs for aquatic weed control. I will also cover case studies that highlight the benefits of using an integrated approach and will provide examples of how IPM is being used for control of a number of invasive plant species.

BIO: Dr. Lyn Gettys is an Assistant Professor of Agronomy at the University of Florida IFAS FLREC in Davie. Dr. Gettys’ research is focused on the biology and ecology of native and introduced aquatic and wetland plants and evaluation of control methods for managing invasive species.

Contact Information: Lyn Gettys, University of Florida IFAS FLREC, 3205 College Avenue, Davie, FL, USA 33314, Phone: 954-577-6331, Email: lgettys@ufl.edu

UNIQUE ROLE OF THE A.R.M. LOXAHATCHEE NATIONAL WILDLIFE REFUGE IN THE GREATER EVERGLADES LANDSCAPE

Rebekah Gibble
U.S. Fish and Wildlife Service, Boynton Beach, FL USA

Arthur R. Marshall Loxahatchee National Wildlife Refuge is a 144,000 acre wetland that is the northern most remaining vestige of the historic Everglades. The refuge is primarily bounded by urban and agricultural land uses. Runoff from adjacent areas is treated by two Storm Water Treatment Areas situated directly to the northeast and northwest of the Refuge. The refuge is a unique mosaic of habitat types and is politically, economically, and ecologically important from local and landscape perspectives. Loxahatchee Refuge is distinctly situated on state-owned lands, but is managed by USFWS under the guidelines in a License Agreement in effect since 1951 and last signed in 2000. The lands are managed with interagency coordination for multi-purpose use. Management objectives include supporting critical ecological needs for numerous protected species, as well as providing urban and agricultural water supply and flood control.

Politically, the refuge is the site of an ongoing lawsuit regarding water quality that seeks to protect habitats and ecology of the refuge and beyond. This lawsuit revolves around the refuge's position as the entry-point for much of the water that flows through the remaining Everglades. Economically, the Refuge attracts 350,000 visitors per year, significantly contributing to the eco-tourism industry in South Florida. Ecologically, the mosaic of habitats found within the refuge marsh is an important site for wading bird foraging and is used by other protected species such as snail kites, alligators, and wood storks. The refuge faces extreme challenges in controlling invasive plant species that have spread to the refuge from adjacent areas and have grown into dense populations that threaten other adjacent areas in addition to trying to prevent, mitigate, and/or monitor new plant and animal invasions from spreading to the refuge from other areas, such as laurel wilt disease, pythons and Nile monitors. These invasive species threaten all the resource values of the refuge and are a major focus of management activities.

Refuge management highly values the importance of managing adaptively, working cooperatively, and being engaged in landscape conservation efforts. For example, strategies used for invasive species control are a combination of conventional treatment applications as well as innovative approaches that have been developed in collaboration with state partners and incorporate fire as a tool. Scientists at the refuge are also developing tools to monitor potential impacts of water quality on habitat integrity, as well as a unified hydrological performance metric system for evaluation of hydrological conditions in terms of established ecological targets. Refuge staff is also engaged with widespread conservation efforts by the interagency Peninsular Florida Landscape Conservation Cooperative.

The distinct habitats, management, and position in the landscape give Loxahatchee Refuge a unique role and value to the Everglades system. The use of the refuge by trust resources such as wading birds, snail kites, as well as ongoing refuge management activities such as water operations and habitat management, and their role in the landscape will be discussed.

BIO: Rebekah Gibble is the Senior Wildlife Biologist at the A.R.M. Loxahatchee NWR. Rebekah oversees the biology program, including water quality, invasive species, and wetland ecology. She holds a Ph.D. in Toxicology from the University of Louisiana – Monroe and has over 12 years of professional experience working in the northern Everglades.

Contact Information: Rebekah Gibble, U.S. Fish and Wildlife Service, 10216 Lee Rd, Boynton Beach, FL USA 33473, Phone: 561-735-6038, Email: rebekah_gibble@fws.gov

STRATEGIC COMMUNICATION OF RESTORATION COORDINATION VERIFICATION (RECOVER) SCIENCE FOR THE COMPREHENSIVE EVERGLADES RESTORATION PROGRAM

Patricia Gorman
South Florida Water Management District, West Palm Beach, FL, USA

The RECOVER program provides essential support to the Comprehensive Everglades Restoration Plan (CERP) in meeting its goals and purposes by applying a scientific, system wide and integrative perspective to the planning and implementation of the CERP. RECOVER conducts scientific and technical evaluations and assessments for improving CERP's ability to restore, preserve, and protect the South Florida ecosystem while providing for the region's other water-related needs. RECOVER communicates and coordinates the results of these evaluations and assessments.

The ability of RECOVER to accomplish its mission relies on communication between RECOVER, decision makers, restoration teams, scientists, water managers, and other CERP stakeholders. Since the beginning of the program in the early 2000's RECOVER has communicated the science of this large complicated ecosystem restoration program in a number of ways. There have been conceptual ecological models and performance measures developed, reviewed and web posted. Our major 2-5 year reports include the System Status reports and Report to Congress. Many other supplementary reports and documents such as the new Knowledge Gained document and the Adaptive Management guides have also been instrumental in informing the CERP community. These products are used in planning new projects, provide information about the risks to restoration success associated with uncertainties, and provide information about opportunities for adaptive management. Managers and project delivery teams use this information to make decisions about CERP restoration planning and implementation, and stakeholders become better informed about the status of restoration.

As one part of a forward thinking five year plan developed by the RECOVER team in 2016, RECOVER will be documenting existing strategies for communicating RECOVER science, evaluating communication methods, and developing and implementing new communication strategies. The 2019 System Status Report will be one of the primary products to come out of this effort to improve the communication of our science. The RECOVER team will be partnering with the University of Maryland Center for Environmental Science (UMCES), Integration and Application Network (IAN). This partnership will bring together the highly skilled and experienced group of South Florida Scientists that have been working with RECOVER for many years with the IAN team which is a unique combination of scientists and communicators who share a common passion for bringing science to life. The goal is to improve the integration and communication of our extensive body of knowledge in order to reach a wide ranging audience of scientists, resource managers, engineers, policy makers, stakeholders and the interested public.

<u>BIO</u>: Patricia Gorman is currently working as a Science Supervisor for the Coastal Ecosystem Section of the SFWMD. She is the program manager for the Multi-agency Comprehensive Everglades Restoration Project's RECOVER science program. She has been involved in CERP/RECOVER science for over 20 years. In her previous position as the Director of the Upper East Coast Division (UEC) of the SFWMD she was responsible for all ecosystem restoration activities in St. Lucie, Martin and Palm Beach Counties. Ms. Gorman has worked extensively in the UEC region, was the Indian River Lagoon Surface Water Improvement and Management Plan manager. Ms. Gorman has been employed by the SFWMD for over 27 years. She received a degree in Environmental Technology from Florida Institute of Technology and a Biological Sciences degree from Florida Atlantic University.

<u>Contact Information</u>: Patricia Gorman South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, Florida 33455, Phone: 561-682-2432, email: pgorman@sfwmd.gov

EFFECT OF LIME ROCK SUBSTRATES ON STORMWATER TREATMENT AREA WATER QUALITY AND VEGETATION CHARACTERISTICS

***Kevin A. Grace*[1]**, *D. Sierer Finn*[1], *Michael Jerauld*[1], *Karen Hileman*[1], *Jaimee Henry*[1] *and Delia Ivanoff*[2]
[1]DB Environmental, Inc., Rockledge, FL
[2]South Florida Water Management District, West Palm Beach, FL

Wetland substrates can influence phosphorus (P) cycling within the water column, both directly through soil-water interactions and indirectly by influencing macrophyte growth characteristics. In the Everglades stormwater treatment areas (STAs), muck soils exist above the limestone bedrock and comprise a substantial nutrient reservoir that may limit P reductions from surface waters to target levels (at or below 13 µg/L). In this study, we examined interactions between submerged aquatic vegetation (SAV) and underlying substrates by establishing replicated flow-through mesocosms on P-enriched muck soils, with or without a lime rock (LR) gravel cap above the muck (inflow water TP = 16 ± 1 µg/L; 18 bi-weekly measurements over 8 months). In mesocosms without LR, benthic periphyton failed to develop on the enriched muck substrate and surface water TP was strongly influenced by macrophyte presence. In the absence of macrophytes, water column TP concentrations increased to 40 ± 11 µg/L (mean ± SE of three replicate mesocosms under each treatment) and phytoplankton proliferated, whereas outflows from mesocosms with SAV remained close to inflow levels (17 ± 0.7 ppb). In mesocosms where LR was added, the substrate was colonized by benthic periphyton and the influence of SAV (*Chara* sp. and *Potamogeton illinoensis*) on water column TP was diminished. Phosphorus uptake by benthic periphyton and P sorption onto LR were likely the mechanisms that reduced soil P export to the water column and subsequent phytoplankton growth, regardless of the presence of macrophytes. A LR cap also reduced SAV biomass and tissue P content, as compared to mesocosms without LR. Lowest water column TP concentrations (outflow TP = 9 ± 0.3 µg/L) were observed in treatments capped with LR but without SAV. We hypothesize the LR substrate enhanced periphyton growth and provided P sorption capacity, while absence of SAV eliminated transfer of soil P via mining. Findings from the mesocosm experiment compared favorably with observations in a 40-ha pilot study in STA 3/4, where muck soils were removed to expose the underlying LR surface and where low outflow P concentrations (≤ 13 µg/L) have been achieved over a 9-year period of operation.

These results provide insights into the processes that affect water column P reductions in the outflow region of STAs. Namely, that under low surface water P loading conditions (typical of the STA outflow region), transfer of P from the wetland substrate to the water column via rooted macrophyte growth and senescence may compromise P removal objectives. Further, a LR substrate added as a cap above muck soils can limit both direct and indirect pathways for the stored soil nutrients to recycle into the water column. Depending on as yet undetermined factors such as longevity of “capping” benefits and cost, LR substrates may have a role to play in optimizing P removal by STAs to the low levels required for Everglades restoration.

BIO: Mr. Grace is an Associate Scientist with DB Environmental and has over 15 years of experience in phosphorus cycling in aquatic ecosystems, treatment wetland optimization, water quality assessments and biomonitoring. He earned a MS in Soil and Water Science from the University of Florida, and lives in Gainesville, FL.

Contact Information: Kevin Grace, DB Environmental, Inc. 6342 NW 18th Drive Suite #6 Gainesville, FL, Phone: 352-262-8987, Email: kevin@dbenv.com

OPTIONS TO REDUCE HIGH VOLUME FRESHWATER FLOWS TO THE ST. LUCIE AND CALOOSAHATCHEE ESTUARIES AND MOVE MORE WATER FROM LAKE OKEECHOBEE TO THE SOUTHERN EVERGLADES

Wendy Graham
Chair of the University of Florida Technical Review Team, Gainesville, FL, USA

It is widely recognized that the flood control and water delivery system that serves Florida's urban and agricultural interests has substantially and adversely impacted natural ecosystems in south Florida, including the St. Lucie and Caloosahatchee estuaries, Lake Okeechobee and the Everglades Protection Area (EPA). The environmental problems stem from periods when there is too much water, periods when there is too little water, and a regional delivery system that quickly transports nutrients from upstream agricultural and urban sources to natural systems where adverse impacts occur. When South Florida receives a large amount of rainfall, there are often damaging freshwater discharges to both east coast and west coast estuaries, whereas prolonged drought strains the capacity of the regional system to deliver sufficient water to its full complement of end users. Regardless of the regional hydrologic regime, much of the EPA remains chronically deprived of fresh water necessary to sustain remnant habitats and native biota.

In response to stakeholder concerns about the timing and completion of South Florida Ecosystem restoration, the 2014 Florida Senate authorized an independent technical review of options to reduce high volume freshwater flows to the St. Lucie and Caloosahatchee estuaries and move more water from Lake Okeechobee to the Everglades, to be conducted by the University of Florida (UF) Water Institute. Specifically, the interdisciplinary UF Technical Review Team was charged with reviewing existing documents that have set forth plans and projects to reduce regulatory discharges from Lake Okeechobee to the St. Lucie and Caloosahatchee estuaries and increase the flow of water from the lake to the southern Everglades; identifying scientific, engineering, legal and institutional constraints to implementing the identified plans and projects; and identifying options for accelerated and more effective protection of the estuaries and restoration of the Everglades. Key findings of the Technical Review Team will be summarized in this presentation.

BIO: Professor Wendy Graham is the Carl S. Swisher Eminent Scholar in Water Resources in the Department of Agricultural and Biological Engineering at the University of Florida and Director of the University of Florida Water Institute.

Contact Information: Wendy D. Graham, PO Box 116601, University of Florida, Gainesville Florida, 32611-6601 **P**hone: (352) 294-7741, Email: wgraham@ufl.edu

MODELING OF THE PSRP SOUTH WEST FLOOD PROTECTION FEATURES IN THE GRIDDED SURFACE SUBSURFACE HYDROLOGIC ANALYSIS TOOL

Jaime A. Graulau-Santiago[1]*, Xiaodan Song*[1]*, Charles Downer*[2] *and Cary B. White*[1]
[1]Interagency Modeling Center, West Palm Beach, FL, USA
[2]USACE Engineering Research and Development Center, Vicksburg, MS, USA

This presentation describes the development and application of the USACE physically-based Gridded Surface Sub-surface Hydrologic Analysis (GSSHA) model for the assessment of seepage and hydroperiods within the influence area of the Picayune Strand Restoration Project (PSRP). GSSHA was selected due to its ability to simulate fully coupled rainfall distribution, extraction, retention, overland flow, and one dimensional channel flow and the capability to develop inset sub-models within the boundaries of a larger model domain (telescopic refinement). This capability allows for higher resolution analysis and refinement of areas where seepage management and hydroperiod issues were identified.

Hydrologic and hydraulic models were developed from existing and design data, populated with parameters values derived from a calibration method using automatic techniques via the Parameter Estimation and Uncertainty Analysis package (PEST). The methods in PEST use the Secant Levenber-Marquardt (SLM) nonlinear least squares minimization computer-based local search technique.

The models in this project have been used to refine the project feature design to mitigate for unanticipated impacts in the fully restored project conditions.

BIO: Dr. Jaime A. Graulau-Santiago is the co-manager of the Interagency Modeling Center. He has been working with hydrologic modeling for the CERP for the past 11 years. His expertise include regional and sub-regional model applications for ecosystem restoration.

Contact Information: Jaime A. Graulau-Santiago, Interagency Modeling Center/SFWMD, 3301 Gun Club Rd, West Palm Beach, FL, USA 33406, Phone: 561-682-6095, Email:Jaime.A.Graulau-Santiago@usace.army.mil.

HIGH BIOTIC MERCURY IN SOUTH FLORIDA WETLANDS: FISH TROPHIC POSITION AND WADING BIRD REDISTRIBUTION

Binhe Gu[1] *and Paul Julian*[2]
[1]South Florida Water Management District, West Palm Beach FL, USA
[2]Florida Department of Environmental Protection, Fort Myers, FL USA

Previous and current studies on the mechanisms leading to high mercury levels in aquatic biotas typically focus on factors controlling in-situ mercury methylation. These factors include, but are not limited to, mercury, sulfate, dissolved organic matter and types of microbial methylators. While these factors play important roles on mercury methylation and accumulation in biota, the highly variability between these factors and methylmercury levels in water and biota remain unexplained. Additional factors such as fish diets, trophic position and allochthonous sources of mercury may also influence mercury level in biota and account for some significant variances in the relationship between environmental factors and biotic mercury levels.

Metal concentrations in aquatic consumers typically increases along the food chain. Fish trophic position or trophic levels differs among habitats and ecosystems largely due to differences in diets. Stable isotope analysis performed on largemouth bass and its potential dietary organisms were collected from sites within the Everglades ecosystem and were used to determine largemouth bass trophic position. This analysis reveals that mercury tissue concentrations correspond with largemouth bass trophic position. The difference in largemouth bass trophic position among monitoring sites is thought to relate to the type of prey available to fish.

In addition to trophic position, allochthonous sources of mercury accumulated within the ecosystem could also explain high mercury concentrations in biota. Within the ridge and slough landscape mercury has accumulated in tree islands initially transported and concentrated by wading birds and subsequently transported to the surrounding marsh via stormwater runoff. Limited data from soil and water collected at a tree island area named Alley North and surrounding marsh in Water Conservation Area 3 revealed mercury levels several fold greater than the average soil and water mercury levels in the Everglades. The inter-system (highland to wetland) transport of mercury may help explain mercury hotspots unexplained by other environmental factors.

BIO: Dr. Gu is a lead scientist with over 20 years of experience on wetland biogeochemistry and food web studies in the Everglades. He has extensive experience with stable isotope ecology and aquatic ecology.

Contact Information: Binhe Gu, Water Quality Bureau, South Florida Water Management District, 3301 Gun Club Road West Palm Beach, FL 33406; Email: bgu@sfwmd.gov

INFLUENCE OF SOIL DISTURBANCE AND FIRE ON THE DISTRIBUTION OF CAESAR'S WEED (*URENA LOBATA*) IN PINE FLATWOODS

Brian W. Benscoter and ***Daniel H. Hagood***
Florida Atlantic University, Davie, FL, USA

Pine flatwoods are the most extensive terrestrial ecosystem in Florida and prescribed burning is a common management practice, as frequent surface fires maintain understory plant and animal diversity in this fire-adapted ecosystem. However, open space and resource availability from burning can also open the door for invasion of exotic plants like Caesar's weed (*Urena lobata*), a Category I invasive spreading throughout subtropical and tropical ecosystems. It is a rapid growing annual plant that is often observed following prescribed fires. Novel soil disturbances present unique problems for the management of native ecosystems. Disturbed soils such as tilled fire breaks or rootings of feral swine (*Sus scrofa*) often have high densities of Caesar's weed. However, the distribution responses to burning and soil disturbance that may control Caesar's weed spread are poorly understood. To better inform land management practices, we assessed the response of Caesar's weed germination to seed heating and soil disturbance. Using a factorial field manipulation, we quantified invasion success in response to soil disturbance and winter prescribed burning, as well as whether soil seed banks or post-disturbance dispersal was responsible for invasion. We also quantified heat tolerance of Caesar's weed seeds both in the canopy and soil seed bank to determine if the timing or intensity of prescribed burning influences germination success.

Caesar's weed presence increased in plots that were exposed to a winter prescribed burn, both with and without soil disturbance. Short exposure to fire significantly increased the germination rates of Caesar's weed seed, while prolonged exposure to fire destroyed seeds. Caesar's weed produces bur encapsulated seeds that appear to be dispersed, scarified and buried by feral swine during rooting, which increases the distribution and germination of Caesar's weed. With this information, land managers can make science-based decisions regarding the timing of prescribed burning to maximize removal and minimize facilitation of Caesar's weed in pine flatwoods. Additionally, synergism between invasive soil disturbers (i.e., feral swine) and invasive plants results in novel ecology that may require novel conservation strategies in managed ecosystems.

BIO: Daniel Hagood is a Florida Atlantic University Graduate student who is presenting his master's thesis project. He has a bachelor's of science in Environmental, Soil and Water Science and is pursuing a master's of science in Environmental Science.

Contact Information: Daniel Hagood, Florida Atlantic University, 3200 College Ave, Davie, FL, USA 33314, Phone: 870-245-6652, Email: dhagood2014@fau.edu

VALIDATION OF NEAR-TERM EVERGLADES WATER DEPTH FORECASTS

Saira Haider[1]*, James Beerens*[1]*, Leonard Pearlstine*[2]*, Kevin Suir*[3]*, Gregg Reynolds*[2]*, Stephanie Romañach*[1]

[1]U.S. Geological Survey, Davie, FL, USA
[2]Everglades National Park, Homestead, FL, USA
[3]U.S. Geological Survey, Lafayette, FL, USA

The ecological integrity of Florida's Everglades is driven by water flows, depths, distribution, and quality. We developed the Everglades Forecasting (EVER4CAST) application that produces simulations of forecasted water levels to determine optimal outcomes for a suite of ecological responses (e.g., endangered species, wading birds, prey fishes). This quantitative application allows decision makers to identify management actions that can benefit a suite of ecological communities, while explicitly quantifying the potential costs to others.

EVER4CAST creates near-term (up to 6-months) forecasted water levels at over 200 gauges in South Florida by comparing real-time stage values from the Everglades Depth Estimation Network (EDEN) to a set of historic stage values from the Regional Simulation Model (RSM) or EDEN. Adjusting for forecasted precipitation, the model repeatedly selects the closest one-month RSM or EDEN analog to real-time conditions and uses the daily rate of change (i.e., recession rate) to construct a forecasted stage at each water level gauge. The gauge values are then processed for each cell using the EDEN interpolation over the 400-m^2 EDEN spatial extent.

From 1995 until 29 Sept 2015, we ran EVER4CAST, quarterly, to validate the EDEN and RSM central tendency outputs to observed historical values at the gauges. In this exercise, we calculated deviations from observed water stage values and generated error statistics for the two estimation methods (EDEN and RSM). For each, we calculated root mean squared error (RMSE), mean absolute error (MAE), and mean biased error (MBE) for each gauge to analyze the overall performance of the forecasts. RMSE and MAE measure residual errors, and RMSE measures error magnitude and gives greater weight to larger errors. MAE measures model bias, and MBE shows over and under predictions of the water stage level as positive and negative values.

Using the deviations, we graphed and examined water stages for which the individual EDEN or RSM gauge estimations were less accurate. From the error statistics for each gauge, we determined seasonal trends in accuracy and extrapolated a continuous surface map over the spatial extent of the Florida Everglades to examine and illustrate overall model success in water stage forecasting.

BIO: Saira Haider is an Ecologist at the USGS Wetland and Aquatic Research Center (WARC). Saira's research interests include using ecological modeling and spatial statistics with open sourced software to improve conservation efforts.

Contact Information: Saira Haider, Wetland and Aquatic Research Center, U.S. Geological Survey, 3321 College Ave., Davie, FL 33314 USA, Phone: 954-377-5985, Email: shaider@usgs.gov

LONG-TERM CHANGES IN FLORIDA BAY SEAGRASS COMMUNITIES: TALES OF RESILIENCE AND VULNERABILITY?

***Margaret O. Hall* [1]**, *Bradley T. Furman*[2], *Michael J. Durako*[3], *Manuel Merello*[1], *and S.S. Bell*[4]
[1]Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL, USA
[2]University of Virginia, Charlottesville, VA, USA
[3]University of North Carolina at Wilmington, Wilmington, NC, USA
[4]University of South Florida, Tampa, FL, USA

Florida Bay seagrass communities, dominated by *Thalassia testudinum* (turtlegrass), form some of the largest continuous meadows in the world. In late summer 1987, extensive areas of dead or rapidly dying *Thalassia* were reported in north-central Florida Bay. The die-off was initially most prevalent in dense turtlegrass meadows adjacent to mudbanks, but eventually entire basins were affected. Although the rate of die-off declined from 1990-91, widespread turbidity due to resuspended sediments and phytoplankton blooms resulted in secondary losses of all seagrass species through the late 1990s.

The Fisheries Habitat Assessment Program (FHAP), led by the Florida Fish and Wildlife Conservation Commission (FWC), has systematically surveyed seagrass and macroalgal species composition, distribution, and abundance in 10 Florida Bay basins using a modified Braun-Blanquet abundance technique since 1995. During the past 20 years, recovery of the Florida Bay seagrass community largely followed expected successional patterns, with primary colonization and early increases by the fast-growing species *Halodule wrightii* and *Syringodium filiforme*, eventually followed by increases in the slower-growing climax species *Thalassia*. Beginning in 2009, FHAP data indicated a near-complete recovery of turtlegrass-dominated communities in even the most affected basins - Rankin Lake, Whipray and Johnson Key. However, large die-off patches (10-100s of meters) were observed in these basins in May 2012, suggesting that *Thalassia* density had increased to the point where the community was again potentially vulnerable to a large-scale die-off event given appropriate environmental conditions (i.e. excessively high salinities and/or temperatures).

In mid-July 2015, researchers working in Everglades National Park reported extremely elevated salinities (50-70 PSU), major fish kills, and renewed rapid turtlegrass die-off in the north-central bay. Results from FHAP surveys in October 2015 and May 2016 revealed an almost complete loss of *Thalassia* in Rankin Lake, and substantial losses in portions of other basins, particularly Johnson Key. Recent observations (November 2016) suggest that *Halodule* cover has expanded in many die-off patches. The presence of remnant turtlegrass patches, aerial *Thalassia* shoots which have produced multiple apical meristems, and the occurrence of surviving *Thalassia* seedlings provide additional evidence of community recovery. Although succession appears to be progressing, the recovery trajectory from the recent seagrass die-off is currently unknown, and will depend on multiple environmental factors, particularly the stalling effects of anticipated phytoplankton blooms.

BIO: Margaret O. Hall (Penny) is a research scientist at the Florida Fish and Wildlife Research Institute, and has participated in wide range of seagrass research activities during the past 30 years. She has worked in Florida Bay since 1994, and led the South Florida Fisheries Habitat Assessment Program since 2005.

Contact Information**:** Penny Hall, Florida Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 100 Eighth Ave. SE, St. Petersburg, FL, USA, 33701, Phone: 727-892-4155, Email: penny.hall@myfwc.com

SURVEY FOR LYGODIUM MICROPHYLLUM AND OTHER INVASIVE EXOTIC SPECIES ON TREE ISLANDS IN WATER CONSERVATION AREA 3

Helen E. Hammond[1]*, Mary-Jo Hernandez*[1]*, Joaquin Alonso*[1]*, Sharon Ewe*[1] *and Martha Nungesser*[2]
[1]Ecology and Environment, Inc., Wellington, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL USA

South Florida Everglades ecosystems are dominated by extensive marsh lands spotted with tree islands of varying shapes and sizes. These tree islands have formed, changed, adapted and even been eliminated as a result of increasing hydrological demands of south Florida's growing human population. This project focused on Everglades tree islands as habitat for invasive exotic species. Ecology and Environment, Inc. (E&E) has conducted multiple surveys to collect quantitative and qualitative data on the presence and abundance of invasive exotic plant species within tree islands in Water Conservation Area 3A (WCA-3A). Focusing on *Lygodium microphyllum*, biologists surveyed tree islands using a standardized method of transects. The E&E team located, identified, and potentially treated *L. microphyllum* (Old World climbing fern) while also noting other Class 1 Invasive Species. Other infestations such as *Paratachardina pseudolobata* (lobate lac scale) and the presence of laurel wilt caused by the fungus *Raffaelea lauricola* were also noted. At the same time, additional ecological data were collected from the interior and exterior of the islands.

E&E has conducted surveys for exotics in WCA-3A for multiple years. In the 2010 survey by E&E, 14.6% of 41 islands surveyed had *L. microphyllum.* Of the 38 islands surveyed in 2015-2016, *L. microphyllum* was found on 4 islands (10.5%). Although there is not a clear pattern of *L. microphyllum* infestations, three of the four islands found to have *L. microphyllum* were less than 5 miles from major roadways and areas of human activity. Other exotics noted during this survey were *Schinus terebinthifolius* on 3, *R. lauricola* on 14, *P. pseudolobata* on 26 and *Syngonium podophyllum* on 1 island.

The findings from the 2015-2016 survey indicated that continued monitoring of the tree islands is needed, regardless of location or size because the distribution of *L. microphyllum* and other invasive exotic species across WCA-3A cannot be generalized at this point. A new round of surveys has begun to visit islands not previously surveyed as well as returning to several islands to check for re-growth of treated *L. microphyllum* populations.

<u>BIO:</u> Ms. Hammond is a biologist with 10 years of experience conducting ecological research and monitoring projects in South Florida. Ms. Hammond manages the Invasive Exotics Survey project, manages a database of automated and analytical water quality data, and works on hydrologic and ecological monitoring for a long-term project.

<u>Contact Information</u>: Helen Hammond, Ecology and Environment, Inc., 12300 South Shore Blvd., Suite 222, Wellington, FL, USA 33414, Phone: 561-793-3849, Email: hhammond@ene.com

ASSESSMENT OF PYTHON AND BOA RECORDS FROM THE FLORIDA KEYS

***Emma B. Hanslowe*[1]**, *Bryan G. Falk*[1], *and Robert N. Reed*[2]
[1]U.S. Geological Survey, Homestead, FL, USA
[2]U.S. Geological Survey, Fort Collins, CO, USA

The first documented reports of nonnative pythons and boas from the Florida Keys occurred in 2002 and have since increased in frequency and credibility. A comprehensive summary of these reports is important for understanding propagule pressure, spatiotemporal trends, and establishment risk of these species to the Florida Keys. We compiled records of pythons and boas from the Florida Keys using available sources of information (Early Detection and Distribution Mapping System, Everglades National Park, Florida Museum of Natural History, Monroe County Sheriff's Office, our records, media accounts, and local contacts), cross-referenced them to eliminate duplicates, and categorized each record's credibility. Over 100 specimens and/or reported sightings of six python and boa species have occurred in the Florida Keys over the past 15 years, and Burmese pythons (*Python molurus bivittatus*), boa constrictors (*Boa constrictor*), and ball pythons (*Python regius*) are the most frequently reported species. Three hatchling Burmese pythons were captured on northern Key Largo in 2016, suggesting that the species may be newly established on that island. Both the expanding mainland Burmese python population and ongoing python and boa introductions via the pet and cargo industries keep propagule pressure high. To prevent establishment and associated ecological impacts of python and boa species in the Florida Keys, there is a need for effective public outreach to solicit reporting of sightings, as well as development of early detection and rapid response networks.

BIO: Emma received a B.S. in Wildlife and Conservation Biology from the University of Rhode Island and has been a biological science technician with the USGS Invasive Species Science Branch for two years. She currently oversees a variety of invasive reptile field and laboratory work in the Greater Everglades Ecosystem.

Contact Information: Emma B. Hanslowe, U.S. Geological Survey, 40001 State Road 9336, Daniel Beard Center, Homestead, FL, USA 33034, Phone: 305-242-7852, Email: ehanslowe@usgs.gov

FORECASTING INSHORE RED TIDE BLOOMS USING RECENT PAST OFFSHORE CONDITIONS ON THE WEST FLORIDA SHELF

***WJ Harford*[1]**, *MB Rykowski*[2], *EA Babcock*[2], *M Karnauskas*[3], *SR Sagarese*[3], *JF Walter*[3]
[1]Cooperative Institute for Marine and Atmospheric Studies, University of Miami, Miami, FL, USA
[2]Department of Marine Biology and Ecology, University of Miami, Miami, FL, USA
[3]NOAA Southeast Fisheries Science Center, Sustainable Fisheries Division Miami, FL; USA

Harmful algal blooms, known as “red tide” (*Karenia brevis*), are responsible for massive fish kills, marine mammal deaths, and human illness. The complex suite of physical and ecological interactions that give rise to severe red tide events presents a considerable challenge to the development of short-term forecasting models. Such models could improve reliability of human health warnings and the timeliness of environmental monitoring, and could reveal causative pathways in everglades ecology. We provide a step-by-step overview of Empirical Dynamic Modeling (EDM), which is a non-parametric technique that relies on sequences of empirical observations, rather than mechanistic equations, to produce short-term forecasts. EDM is an advanced approach for modeling complex systems and can produce accurate forecasts despite interactions among a large number of variables. The approach is amenable for modeling both linear and non-linear systems, but EDM typically outperforms traditional statistical methods in forecasting highly non-linear ecological responses. Using the example of severe red tide occurrence, we walk through EDM as a means to translate knowledge about key variables, and the complex circumstances under which these variables interact, to produce 2-3 month advance forecasts. The key innovation offered by EDM lies in its modeling flexibility that is made possible because no *a priori* sets of equations are needed to represent the dynamics of ecological systems.

BIO: Bill is an assistant scientist with the Cooperative Institute of Marine and Atmospheric Studies at the University of Miami. He has experience with fisheries management and has been involved in designing harvest strategies that are responsive to red tide-induced fish kills. He is also interested in forecasting models that can improve management decisions.

Contact information: Bill Harford, Cooperative Institute for Marine and Atmospheric Studies, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Cswy, Miami, FL, 33149. Ph: 305-421-4472,
Email: william.harford@noaa.gov.

PASSIVE ACOUSTIC TRACKING OF MARINE TURTLES IN CORAL REEF SEASCAPES

Kristen M. Hart[1], *Thomas H. Selby*[2], *Michael S. Cherkiss*[1], *Andrew G. Crowder*[3], *Ikuko Fujisaki*[2], *Autumn Iverson*[3]
[1]USGS Wetland and Aquatic Research Center, Davie, FL, USA
[2]University of Florida, Ft. Lauderdale Research and Education Center, Davie, FL, USA
[3]Cherokee Nations, contracted to USGS Wetland and Aquatic Research Center, Davie, FL, USA

Networks and arrays of passive acoustic receivers have been deployed in coastal regions to detect patterns of movement for species of conservation concern including fish, sharks, and marine turtles. We deployed acoustic receivers in two US protected areas (Dry Tortugas National Park [DRTO], south Florida, USA and Buck Island Reef National Monument [BIRNM], St. Croix, US Virgin Islands) to determine movement rates and residency patterns for two species of imperiled marine turtles. In DRTO, tracking of sub-adult and adult green turtles *Chelonia mydas* over ~6 month periods revealed restricted yet overlapping core-use areas located in seagrass habitats. In BIRNM, tracking of juvenile hawksbills *Eretmochelys imbricata* revealed restricted use of primarily reef habitats over ~18 month periods. We also conducted range-testing of receivers in representative habitats around Buck Island, where an array of >100 receivers is maintained through collaborative efforts and unique partnerships. Maximum range of acoustic signals was 213 m in sand habitats, and lower in all other benthic habitat types. Accurate interpretation of acoustic data must include an understanding of receiver range. Further, network analysis can serve as a type of sensitivity analysis to determine receivers driving understanding of animal movement patterns.

<u>BIO</u>: Dr. Hart is a Research Ecologist with more than 15 years of experience in planning, designing, and implementing Everglades restoration projects focused on large reptiles. She has extensive experience with threatened and endangered species population restoration including delineating of animal habitat use patterns throughout marine seascapes.

<u>Contact Information</u>: Kristen M. Hart, Wetland and Aquatic Research Center, 3321 College Avenue, Davie, FL, USA 33314;
Phone: 954-377-5922; Email: kristen_hart@usgs.gov

TESTING THE RESTORATION OF A FREE-FLOWING EVERGLADES: THE DECOMPARTMENTALIZATION PHYSICAL MODEL (DPM) HIGH-FLOW EXPERIMENTS

***Jud Harvey*[1]**, *Laurel Larsen*[2,1], *Jay Choi*[1], *Colin Saunders*[3], *Sue Newman*[3], *Barry Rosen*[4], *and David Ho*[5]
[1]U.S. Geological Survey - National Research Program, Reston, VA, USA
[2]University of California, Berkeley, CA, USA
[3]South Florida Water Management District, West Palm Beach, FL, USA
[4]U.S. Geological Survey, Orlando, FL, USA
[5]University of Hawaii, Honolulu, HI, USA

The amount of flow needed for effective restoration of the Everglades is still debated, in part because the ecological outcomes are difficult to predict. Direct observations of the ecological effects of high flow could resolve important questions such as "how will increased flow restore the iconic deep-water sloughs that are necessary components of a high-functioning Everglades".

The DPM experimental flow way permits direct observation of the hydraulic, sedimentary, and ecological effectiveness of high-flow restoration at a scale (3 km^2) never before attempted in the Everglades. The DPM is located in the heart of restoration's central pathway. The site was selected because it is a degraded area typified by diminished microtopography and loss of deep-water sloughs, and because it will be a "first-responding" area from Everglades restoration.

To test the role of high-flow in restoring well connected deep-water sloughs, we measured the propagation of high-flow pulses and the fate of entrained sediment during transport through the degraded wetland. Three background periods were observed in the fall of 2010, 2011, and 2012 and four flow releases 2-3 months long were observed in the fall/winter of 2013, 2014, 2015, and 2016. Each flow release caused a gravity wave to propagate radially from the opening in the levee outward into the wetland. The greatest influence occurred within 1.5 km of the levee opening, because of the radial flow pattern and because of flow resistance of the dense sawgrass (86% coverage). Within the high-flow footprint the water depth increased from 40 to 55 cm, water flow velocity increased from 0.3 to 6 cm/s, and suspended sediment concentration increased, temporarily, from 0.4 mg/L to as much as 8 mg/L. The suspended sediment was entrained from the flocculent material on the bed of the slough and from epiphyton which grows on stems of submerged plants in the slough. The initial high-concentration pulse of suspended sediment appeared to have been generated by physical disturbance of slough vegetation during the water-level rise. Longer term sediment entrainment (at lower concentration) was related to biogeochemical changes in bed floc that enhanced entrainment of floc particles. Downstream transport of suspended sediment was delayed and attenuated by water exchange between sloughs and ridges, with net deposition occurring on ridges. Our findings are consistent with the hypothesis that sediment redistribution from sloughs to ridges was instrumental in creating self-sustaining deep-water sloughs. Model simulations suggested that the limited footprint of beneficial effects of high flow observed at DPM in the first several years can be expected to expand outward over time as natural processes of slough clearing take hold.

BIO: Dr. Jud Harvey investigates hydrologic transport processes, chemical reactions at interfaces, and their ecological effects in wetlands, streams and rivers throughout the nation He leads the Hydroecology of Flowing Waters team in his position as senior scientist at the National Research Program of the U.S. Geological Survey in Reston, VA.

Contact Information: Jud Harvey, USGS, National Research Program, MS 430 National Center, Reston, VA 20192 USA,
Phone: 703-648-5876, Email: jwharvey@usgs.gov

THE SCIENCE OF STRATEGIC COMMUNICATION

Matthew C. Harwell*, Jeannine L. Molleda, Chloe A. Jackson*
US Environmental Protection Agency, Gulf Breeze, FL

The field of Strategic Communication involves a focused effort to identify, develop, and present multiple types of communication media on a given subject. A Strategic Communication program recognizes the limitations of the most common communication models (primarily “one size fits all” and “presenting everything and letting the audience decide what is important”) and specifically focuses on building a communication framework that is composed of three interlinked pillars:

- Message – Identifying the right content for a given audience and a vehicle
- Audience – Identify the right target group for a given message and vehicle
- Vehicle – Identifying the right types of media for a given message and audience

In addition to serving as an organizational framework, the physical structure of a Strategic Communication plan also can serve as a way to show an audience where they, the message, and vehicle fit into the larger picture (i.e., “you are here”).

This presentation explores the tenets of Strategic Communication and its use in natural resources management as it relates to advancing restoration activities in the Greater Everglades. This presentation is aimed at restoration practitioners and decision makers.

BIO: Dr. Harwell is a Supervisory Ecologist at the Gulf Ecology Division, US Environmental Protection Agency in Gulf Breeze, Florida USA. Matt has spent two decades working on restoration science in multiple systems including Chesapeake Bay, Lake Okeechobee, South Florida and the Greater Everglades, and most recently the Gulf of Mexico. Matt’s areas of specialization include ecosystem assessment, integration and communication of science for decision makers, and adaptive management and ecosystem restoration.

Contact Information: Matthew C. Harwell, Gulf Ecology Division, US Environmental Protection Agency, 1 Sabine Island Drive, Gulf Breeze, FL 32561. Tel: (850) 934-9206, Email: harwell.matthew@epa.gov

MODELING STRATEGIES TO PROVIDE A HOLISTIC PICTURE OF CLIMATE CHANGE AND SEA LEVEL RISE IMPACTS IN SOUTH FLORIDA

Young Gu Her
University of Florida, Homestead, FL, USA

Climate, hydrology, and agriculture closely interact with each other, creating unique landscapes, and each of them cannot be fully understood without consideration of the others. Therefore, climate change and sea level rise adaptation and mitigation planning require a holistic approach covering metrological, hydrological, and agricultural aspects. Mathematical simulation models have served as a useful tool to describe metrological and hydrological processes and their influences on ecosystem in a quantitative manner, giving opportunities to evaluate alternatives and explore the optimum solution in decision making and planning. Numerous models have been developed, but there is no one model capable of providing an integrated view of climate change and sea level rise impacts on hydrology, ecosystem, and agriculture, especially in coastal areas. In addition, hydrologic models tend to focus on either surface water or groundwater, and a few simulate the dynamic linkage between surface water and ground water. We do not have a simulation model capable of explicitly describing relationships among ecosystem, hydrology, and agriculture, which impedes understanding of the overall picture of climate change and sea level rise impacts in South Florida.

Recently, the Intergovernmental Panel on Climate Change (IPCC) launched the Coupled Model Intercomparison Project Phase 5 (CMIP5) in the fifth Assessment Report (AR5), whereby a multiple general circulation model (multi-GCM) ensembles analysis was facilitated through the provision of climate model outputs that comply with community. The multi-GCM ensembles has served as a framework for accommodating probabilistic approaches in interpretation of climate change predictions and decision-making processes, and ensemble averaging can improve the accuracy of a climate projection by allowing GCM errors cancel each other out. The latest project output, CMIP5 has known as the most advanced generation of climate models, and thus it is desired to use them in new climate change impact studies. However, it has not been extensively utilized in climate change impact analysis yet due to the relatively short exposure to the public. Many climate models and their projections are currently available, but climate change studies have employed only a few of them depending on the preference of a modeler and the ease of use, which leads to the neglect or underestimation of uncertainty and bias in the ensemble predictions of climate change. In addition, there is no study identifying GCMs that is the most appropriate to Florida in terms of the reliability and accuracy as Florida has extreme regional and localized weather events such as hurricanes and heavy rains.

The overarching goal of my study is to develop a simulation strategy providing a holistic view of climate change and sea level rise impacts on South Florida's agriculture and hydrology, especially salinity in historically fresh water supplies. The presentation will talk about how to (1) develop an integrated simulation tool capable of describing interactions between surface water, soil water, groundwater, brackish water, seawater, crops, and agricultural management practices and (2) develop an ensemble of comprehensive climate projections for South Florida using the up-to-date climate models and scenarios.

BIO: Dr. Her is an assistant professor at the University of Florida. Dr. Younggu Her's research interests are in enhancing our ability to manage water quantity and quality in sustainable ways by developing integrated hydrological modeling tools and frameworks and creating new scientific knowledge that helps us better understand hydrological processes.

Contact Information: Young Gu Her, Tropical Research and Education Center / Agricultural and Biological Engineering Department, 18905 SW 280th St., Homestead, FL, USA 33031-3314, Phone: 786-217-9288, Email: yher@ufl.edu

FINE SCALE TRACKING OF WATER LEVEL BY SUNFISH: IMPLICATIONS FOR WADING BIRD FORAGING

***Gregory J Hill*[1]**, *Jennifer S. Rehage*[1], *Mark Cook*[2], *Eric Cline*[2], *Jesse Blanchard*[1], *Rolando Santos Corujo*[1]

[1]Florida International University, Miami, FL, USA
[2]South Florida Water Management District, FL, USA

Linkages among hydrological variation, prey dynamics and wading bird foraging and nesting success remain poorly understood, yet are critical to Everglades restoration and water management. A key unknown is how hydrological variation affects fish distribution and habitat selection across the landscape, influencing prey concentrations and their accessibility to wading birds. In this study, we used a combination of tagging and enclosure techniques to experimentally manipulate water levels and examine effects on fish movement and distribution. More specifically, we asked: Do fish respond differently to 1) increasing vs decreasing water levels, and 2) to seasonal vs. unseasonal (referred to as reversal hereafter) variation in water levels? We also use results from this study to interpret how reversals may influence the availability of fish as bird prey in the slough habitat.

Hydrological reversals are of interest because they disrupt water recession patterns and allow fish to disperse over a larger area, which may affect wading bird foraging dynamics. Our study was conducted at the Loxahatchee Impoundment Landscape Assessment (LILA) where we could experimentally create reversals. Low frequency Radio Frequency Identification (RFID) technology was used to continuously track the movement and habitat use of spotted sunfish (*Lepomis punctatus)* tagged with 23 mm Passive Integrated Transponder (PIT) tags in six large replicate in situ enclosures over a period of 8 months (January-August 2015). We compared daily activity (number of movements between habitats) across days of varying hydrological conditions.

Spotted sunfish were more responsive to increases in water levels, rather than receding conditions. As water levels increased, fish became more active moving between habitats and showed a higher likelihood of being present in the slough during morning & evening hours. The increasing water levels during the reversal induced the highest levels of fish activity, higher than those seen in 'seasonal' increases in stage. The rate of increase vs. decrease mattered to fish as well. Sunfish increased activity at all rates when water was increasing, but only responded to decreases in stage if the rate was uncharacteristically fast (3+ cm/day). Our results show that fish are highly sensitive to rate & direction of stage, triggering rapid movements that result in redistributions over the landscape with possible trophic cascade implications for birds.

BIO: Greg Hill is a Masters student at Florida International University completing thesis work on fish movement and habitat selection in the Everglades and has been working on the LILA fish movement & habitat selection study since 2013.

Contact Information: Gregory J. Hill, Florida International University, 11200 SW 8th street, Miami, FL 33199 USA, Phone: 715-340-3081, Email: ghill007@fiu.edu

BEHAVIORAL RESPONSE OF SMALL EVERGLADES FISH TO HYDROLOGICAL VARIATION, PREDATOR CUES AND PARASITES

***J. Matthew Hoch*[1]*,** *Christopher Blanar*[2]*, Stacey Spadafore*[1] *and Domenique Olesen*[1]
[1]Department of Marine and Environmental Sciences, Nova Southeastern University, Fort Lauderdale, FL, USA
[2]Department of Biological Sciences, Nova Southeastern University, Fort Lauderdale, FL, USA

Small fish are important to the Everglades ecosystem as primary and secondary consumers and as a food source for higher trophic levels. In short-hydroperiod wetlands, these fish must migrate to refuge areas or risk stranding, and have been observed to rapidly recolonize during the wet season. Factors that influence the decision to migrate are of interest to water and wildlife managers, because these fish are a very important food resource for wading birds.

The goals of this study are to understand what influences annual migrations to and from short-hydroperiod wetlands. Established work indicates that such migrations are directed and not a result of fish randomly diffusing through the environment. We aim to link individual variation in behavior to population level movement across the landscape. Thus, we tested whether "personality" traits vary in space, time or with external cues. We specifically tested whether the willingness of fish to explore and move through unknown environments varied among species, with hydrological season, wetland hydroperiod, or parasite load (since parasites may reduce fitness or change levels of risk aversion). Fish were filmed exploring an artificial habitat, and we examined data like the time spent hiding, total distance traveled, variation in speed and other movement variables.

We found that behavior varied significantly among species, with eastern mosquitofish (*Gambusia holbrooki)* the boldest and most likely to explore and golden topminnow (*Fundulus chrysotus*) the least so. During periods when water levels fell, sailfin mollies (*Poecilia latipinna*) explored more, increasing likelihood of escaping dry-downs. Most fish were parasitized, some heavily. Some of the parasites were from taxa known to modify host behavior. Each species of fish and region sampled had unique parasite communities.

During these trials we noticed that water quality varied dramatically during the year, and that fish seemed to react strongly to that variation. We tested the hypothesis that waterborne cues might influence willingness to explore, risk aversion and likelihood of entering unknown areas. We used a factorial experimental design to measure effects of visual predator cues (a snowy egret (*Egretta thula*) model), chemical cues (feces collected from a bird rehab center) or food motivation influenced the behavior of eastern mosquitofish. Analysis for parasitism was also conducted on fish from this experiment. To date, small sample size to date limits our ability to draw conclusions from this experiment, but it seems likely that these factors influence fish migration in nature.

BIO: J. Matt Hoch is an associate professor at NSU focusing on research in Everglades ecology, marine ecology and evolution. He has been working in wetlands since 2003 and the Everglades specifically since 2009. Dr. Hoch emphasizes work on Everglades restoration as part of his teaching.

Contact Information: J. Matthew Hoch, Nova Southeastern University, 3301 College Ave, Fort Lauderdale, FL, 33314.
Phone: 954-262-7978, Email: jhoch@nova.edu

USING STRATEGIC COMMUNICATION TO ADVANCE THE MISSION OF THE LANDSCAPE CONSERVATION COOPERATIVES.

Todd E. Hopkins
Peninsular Florida Landscape Conservation Cooperative, Vero Beach, FL, USA

The Lands cape Conservation Cooperative (LCC) communications credo is: Create-Curate-Communicate. We focus more on the LCC Network digital strategy as whole to achieve our communications goal to "*Advance the knowledge of, support for and engagement in landscape-scale conservation across the LCC Network."* The objectives of our digital strategy externally are to communicate science, engage partners, and communicate success. Internally our objectives are to build communications capacity and share best practices. Our "3C" digital strategy uses lccnetwork.org as our Network-wide hub for (1) creating content; (2) curating content; and (3) "communicating" – meaning, building community. What is particularly unique is that our web site was developed so that LCCs could leverage the content management system. We also have the ability to visualize our LCC Social Network (https://lccnetwork.org/network). Our "3C" philosophy transcends into our social media channels as well. We also *Go Beyond Boundaries with Virtual Story Maps to Advance the Mission of the Landscape Conservation Cooperatives*. The story maps highlight LCC activities including developing collaborative landscape-level conservation objectives to inform conservation strategies; understanding the implications of current and future environmental stressors; facilitating the exchange of applied science in natural and cultural resource conservation activities; and developing linkages that connect LCCs to ensure an effective network. Finally, we strategically employ five more standard communications strategies for our LCC Network: Digital Strategy, LCC Outreach, LCC Communications Support, Legislative Strategy, and Partnership Building.

BIO: Dr. Hopkins has held scientific, regulatory, and leadership positions with the USFWS, the FL Department of Environmental Protection's Coastal and Aquatic Managed Areas, and two National Estuarine Research Reserves. He has co-chaired the Everglades Adaptive Assessment and Management Team, and helped write the DOI Science Plan for South Florida.

Contact Information: Todd E. Hopkins, Peninsular Florida LCC, 1339 20th Street, Vero Beach, FL 32960. Tel: (772) 469-4289, Email: todd_hopkins@fws.gov

VEGETATION AND SOIL ELEVATION DYNAMICS IN A MANGROVE-MARSH ECOTONE WITHIN THE PICAYUNE STRAND RESTORATION PROJECT IMPACT AREA

***Rebecca J. Howard**, Richard H. Day, Ken W. Krauss, and Andrew S. From*
U.S. Geological Survey, Wetland and Aquatic Research Center, Lafayette, LA

The Ten Thousand Islands region of southwest Florida is characterized by a complex of mangrove forests and salt, brackish, and fresh marsh habitats. Extensive hydrologic modifications since the 1940's have resulted in decreased freshwater inflow to many wetlands in this area, and decreased inflow has led to changes in vegetation community structure. Successful wetland restoration is dependent on the existence of hydrologic regimes that support development of appropriate soils and the growth and persistence of wetland vegetation. The Comprehensive Everglades Restoration Program (CERP) seeks to restore, protect, and preserve water resources of the greater Everglades region. The Picayune Strand Restoration Project (PSRP) is a component of CERP and encompasses the area of a failed residential development from the 1960s. The goal of the ongoing PSRP is to restore pre-development hydrology, leading to increased freshwater sheet flow to areas south of the development.

We describe vegetation dynamics in a mangrove-to-marsh ecotone on Ten Thousand Islands National Wildlife Refuge, which is within the impact area of the PSRP. Vegetation dynamics are also described for a similar reference area outside the project area, on Big Cypress National Preserve. We found that plant communities at both the impact and reference areas were dynamic and transitioning relative to hydrologic conditions indicative of altered versus more natural flow. Vegetation shifts occurred within the impact area over a 7-year period; cover of marsh herbaceous species varied by location, and an 88% increase in the total number of mangrove seedlings was documented. We attribute these shifts to the modified hydrologic regime, which is characterized by a low volume of freshwater sheet flow compared to historical conditions, as well as increased tidal influence. We also identified a significant trend of decreasing soil surface elevation at the impact area. Increased cover of freshwater to oligohaline herbaceous species in the northern portion of the refuge and a reduction in the rate of mangrove forest expansion landward will reflect historical vegetation patterns. Information from our study characterizing existing vegetation dynamics prior to full implementation of the restoration project is required to document long-term project effects on plant community composition and structure within a framework of background variation, thereby allowing assessment of the project's success in restoring critical ecosystem functions.

BIO: Rebecca Howard, Ph.D., is a research ecologist who studies wetland plant community dynamics and community response to stressors and disturbances in coastal habitats ranging from freshwater to saline.

Contact Information: Rebecca J. Howard, U.S. Geological Survey, Wetland and Aquatic Research Center, Lafayette, LA, Phone: 337-266-8639, Email: howardr@usgs.gov

GENETIC AND GENOMIC POPULATION STRUCTURE AND ENVIRONMENTAL DNA (EDNA) MONITORING OF BURMESE PYTHONS IN THE GREATER EVERGLADES ECOSYSTEM

***Margaret E. Hunter*[1]**, *Robert M. Dorazio*[1], *Gaia Meigs-Friend*[1], *Brian J. Smith*[2], *Daren C. Card, and Kristen M. Hart*[2]
[1]US Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA
[2]US Geological Survey, Wetland and Aquatic Research Center, Davie, FL, USA
[3]University of Texas at Arlington, Arlington, TX, USA

Genetic analysis is an important tool in the study of native and non-native species to aid in natural resource management decisions. Population genetic studies can identify cryptic species and provide information on genetic diversity and population structure. Further, molecular tools can help to delimit source and sink populations and shed light on introduction sources and pathways. Additionally, environmental DNA (eDNA) is a rapidly growing tool for the noninvasive assessment of invasive and imperiled species for conservation and management. To glean information on Burmese pythons, numerous genetic and genomic methodologies have been implemented. The invasive Burmese python occupies thousands of square kilometers of mostly inaccessible habitat in south Florida. The species has had detrimental effect on native mammals and birds throughout the Greater Everglades ecosystem. We developed microsatellite markers for traditional population genetic and pedigree analyses and found low diversity and limited genetics structure. Further, next generation sequencing was used to develop the python genome and identify 20,000 RADseq markers for population structure and genetic adaptation analysis on a genomic scale. Last, a relatively new technique utilizing eDNA was developed for Burmese pythons that uses abiotic samples (e.g. water, soil) to detect shed DNA from animals. Environmental DNA can help to determine invasive and imperiled species' distribution, and estimate occupancy and detection probabilities to inform management actions such as invasive species removal. Using this particular technique, we have detected Burmese pythons along the invasion front prior to visual identification. Further, a novel occurrence and detection model has been developed to provide information on occupancy estimates in specific habitats and address changes in occurrence as the population expands northward. We will continue to develop and expand these genetic and genomic tools to improve management decisions for controlling the expanding population of Burmese pythons.

BIO: Dr. Margaret Hunter uses genetic and genomic tools to inform management of invasive and imperiled aquatic and terrestrial species.

Contact Information: Margaret Hunter, Wetland and Aquatic Research Center, US Geological Survey, 7920 NW 71st Street, Gainesville, FL 32653 USA; Email: mhunter@usgs.govw

POPULATION GENETIC ANALYSIS OF THE ENDANGERED CAPE SABLE SEASIDE SPARROW IN EVERGLADES NATIONAL PARK

Margaret E. Hunter *and Mohammad Jubair*
US Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

Genetic tools are well suited to assess the connectivity of imperiled species established in fragmented or disjunct habitat. To aid natural resource management decisions, genetic information can help to determine the number of breeding groups, the genetic management units across the landscape, and movement corridors. There are nine subspecies of seaside sparrows (*Ammodramus maritimus*) distributed along the east and Gulf coasts from Massachusetts to Texas, yet the federally endangered Cape Sable seaside sparrow (*A. m. mirabilis*) is found only in Everglades National Park in southern Florida. There are currently six subpopulations found in Everglades National Park inhabiting freshwater marl prairies. Habitat availability has diminished due to fires, introduction of exotic plants, and changes to natural water flow resulting in fragmented populations. While other sparrows more easily adapt to changing landscapes and plant species, the seaside sparrows have not shown this pliancy in habitat usage and population numbers appear to be declining. To conduct genetic analysis, feather samples were collected from 48 birds and isolated for DNA. Due to the limited amount of DNA on these small feathers, numerous DNA isolation techniques were tested and optimized and traditional chemical extraction was found to provide the largest yields. To assess connectivity of the subpopulations, only a single mitochondrial DNA locus was published for the subspecies. Therefore, we tested 14 primer pairs at numerous loci and four were identified and sequenced in the Cape Sable seaside sparrow. Low genetic diversity and substructuring was found in all surveyed birds. We are working to include additional samples and identify nuclear loci to inform real-time movements among subgroups and pedigree relationships.

BIO: Dr. Margaret Hunter uses genetic and genomic tools to inform management of invasive and imperiled aquatic and terrestrial species.

Contact Information: Margaret Hunter, Wetland and Aquatic Research Center, US Geological Survey, 7920 NW 71st Street, Gainesville, FL 32653 USA; Email: mhunter@usgs.gov

MICROBIAL DYNAMICS OF THE STAS

Kanika S. Inglett
University of Florida, Gainesville, FL, USA

Sustainable removal of excessive nutrients by constructed wetlands like the Stormwater Treatment Areas (STAs) is greatly dependent on the processes that control retention and transformation within the system. A key driver of these biogeochemical processes are microorganisms. Microbial activity is widely recognized in the functioning of wetlands as it facilitates close coupling between the cycling of different elements which potentially affect the vegetation growth, other microbial activities, and/or other chemical reactions regulating overall water quality. Therefore it is critical to understand the microbial community and its role in the functioning of STAs.
Among the various hotspot zones of the microbial activities in these STAs are water column, soil-water interface (litter, floc material, periphyton) and the root zone of wetland plants (macrophytes). Various factors affecting the structure and function of microbial communities are the vegetation community characteristics (periphyton vs SAV vs EAV), degree and type of nutrient loading, and the flow rate of the inflow water. Little is known about structure apart from studies in Water Conservation Area (WCA) 2 which mostly focus on methanogen populations. The bulk of current knowledge in STAs is based on microbial biomass abundance and stoichiometry, and activity of extracellular enzymes which respond sensitively to both environmental and nutrient conditions. In this, microbial characteristics provide valuable indicators of patterns and processes of STA function.
Though they are similar to a variety of other aquatic habitats, few studies have documented the importance of ecosystem characteristics such as vegetation type, season/temp, and flow on microbial communities in the STAs. Currently, studies are investigating enzyme activities in various STA systems and the relationship of enzyme activities with flow along the gradient from inflow to outflow. Findings are being used to spatially and temporally resolve patterns of microbial nutrient limitation as a regulator of decomposition, nutrient mineralization, and nutrient transport in contrasting vegetation cells and flow conditions. Identifying these factors that drive soil microbial functions, especially enzyme activities, can potentially aid the development of predictive models for restoration of biogeochemical transformations and enhance the success of water quality improvement strategies.

BIO: Kanika Inglett, Ph.D. is a Res. Assistant Professor in the Department of Soil and Water Sciences at the University of Florida. Her research focuses on the mechanistic understanding of microbial processes and microbial ecology to predict their responses to environmental change.

Contact Information: Kanika Sharma Inglett, Soil and Water Sciences Department, 3161 McCarty A, University of Florida, Gainesville, FL, USA 32611, Phone: 352-294-3164, Email: kanika@ufl.edu

CURRENT STATE OF THE STORMWATER TREATMENT AREAS

Delia Ivanoff *and Hongying Zhao*
South Florida Water Management District, West Palm Beach, FL, USA

The Everglades Stormwater Treatment Areas (STAs) have been constructed and are operated to remove excess phosphorus (P) from agricultural and urban runoff before it goes into the Everglades Protection Area. There are currently five STAs providing a total of approximately 57,000 acres of effective treatment area. Since the first STA began operation in 1994 to date, the STAs have treated over 215 thousand hectare-meter of water and retained over 2,220 metric tons of total P (76% P load reduction). The annual flow-weighted mean (FWM) concentration of TP has been reduced from 135 to 32 µg/L. The best performance to date has been achieved in STA-2 and STA-3/4, with a historical mean outflow FWM concentration of 21 and 16 µg/L, respectively.

The operation and management of these large-scale treatment wetlands pose many challenges, including the very low regulatory limit (13 µg/L long-term flow-weighted mean and 19 µg/L annual P concentrations). Other key challenges include controlling the loading into the STAs and sustaining healthy desired vegetation communities. The South Florida Water Management District has been taking steps to control these key factors, including source control upstream of the STAs and the construction of Flow Equalization Basins (FEBs). Aside from attenuating the flows to the STAs, initial year of operation of one of the FEBs indicates significant P load and concentration reduction which greatly benefits the STAs.

Short-term operational decisions for the STAs are based on near-real time data and flow-ways are prioritized based on their condition or constraints while long-term strategies are based on long-term evaluation of STA performance, condition, and scientific findings. Recent data analyses suggest that when these factors are controlled at desirable levels, other factors, e.g. biogeochemical, could be the primary influencing factors on outflow P concentrations at the very back end of the STAs’ flow-ways. Specifically, the recycling of retained P within the STAs, in the soil, floc, and vegetation biomass, and the influence of that on the water column P concentration in the short-term and long-term is currently being investigated under the Everglades Restoration Strategies Science Plan.

This presentation will provide a summary of STA performance, successes and challenges, and the Science Plan implementation.

BIO: Delia Ivanoff is a Section Administrator at the South Florida Water Management District, managing scientific research and monitoring on the Everglades Stormwater Treatment Areas. She has extensive experience with water quality, soil biogeochemistry, and nutrient cycling in Florida wetlands and lake systems. She has authored and co-authored many reports and publications pertaining to these topics.

Contact Information: Delia Ivanoff, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL, USA 33406, Phone: 561-682-2681, Email: divanoff@sfwmd.gov

THE INFLUENCE OF NATIVE TREE EXPANSION ON ECOSYSTEM SERVICES IN THE HEADWATERS OF THE EVERGLADES

Erik N. K. Iverson*, and Elizabeth H. Boughton*
MacArthur Agro-ecology Research Center, Lake Placid, FL, USA.

Savannas cover a fifth of the Earth and provide forage for cattle that support millions of people. However, anthropogenic changes such as fire suppression, elevated CO_2, and increased grazing pressure are causing trees and shrubs to take over many savannas. Woody plant encroachment can reduce ecosystem services; for instance, in US rangelands, a 1% increase in tree cover lowers cattle productivity by 2.5%, likely by diverting net primary productivity from palatable grasses into inedible woody biomass. Rangelands also support biodiversity, carbon sequestration, and water filtration, services that could be impacted or altered by tree and shrub expansion. While tree encroachment can have negative effects on cattle production, trees also produce localized nutrient enrichment which can persist after they are gone. In this way, the localized effects of nutrient enrichment by trees might have a subsequent effect on the grasses that succeed them. It is worth investigating the mechanisms by which tree cover influences the understory because, in areas of low net primary productivity, tree cover expansion is actually associated with increased livestock productivity. The impact of tree cover on the understory is context-dependent, with a wide range of responses documented under different fire, grazing, and nutrient regimes.

Florida supports nearly 5 million ha of subtropical rangelands, mostly in the headwaters of the Everglades, that serve as a crucial refuge for biodiversity and a check on development. We investigated the expansion of two native tree species into pasture and their impact on soil nutrients at the MacArthur Agro-Ecology Research Center (MAERC), a 4,249 ha commercial cow-calf operation northwest of Lake Okeechobee. A previous study found major expansion of hammocks into pasture at MAERC since the 1940s but did not differentiate between species. Using aerial imagery we quantified the expansion rates of Virginia live oak (*Quercus virginiana*) and cabbage palm (*Sabal palmetto*), respectively, over the last 70 years. We then visited either single oaks or palm clusters (as well as the sites of former tree islands, as identified by imagery) and sampled soil nutrients, biomass, and species composition of the understory along N-S transects radiating away from the trunk or center of the tree island. Data analysis is currently underway. Our predictions are that palms are expanding faster than oaks due to superior dispersal, but that oaks are having a larger impact on local nutrient enrichment because of their deeper roots and denser canopies. We also predict that there will be long-term legacy effects of former trees, evidenced by enhanced nutrient levels and altered understory composition. Estimation of the rate and distribution of tree expansion as well as species-specific impacts on pastures will allow the creation of spatially-explicit models for evaluating the impact of bush encroachment on many aspects of Florida rangelands, from soils to productivity to biodiversity.

BIO: Erik Iverson is an intern at MAERC where he studies agro-ecology and ecosystem services in the headwaters of the Everglades. He has studied invasive wetland plants in Southeast Louisiana and monitored surface water on rangelands in Western Colorado. He received his M.S. from Tulane University in May 2016.

Contact Information: Erik Iverson, MacArthur Agro-ecology Research Center, 350 Buck Island Ranch Road, Lake Placid, FL, 33852. Phone: 650-430-9382. Email: eiverso@tulane.edu.

DIET SHIFT OF EGRETS IN RESPONSE TO ENVIRONMENTAL CHANGE

Ashley E. Jackson *and Dale E. Gawlik*
Florida Atlantic University, Boca Raton, FL, USA

An increasing number of species are experiencing human-induced rapid environmental change (HIREC). Environmental modifications can result in deleterious effects for some species, while others adapt and thrive. Behavioral modifications such as diet shift are often an initial response by a species to such changes. Currently, it is difficult to determine which species will utilize diet shifts and in turn, how this will impact the population. To examine the degree to which animals adjust their foraging habitat and behavior to accommodate rapid environmental change, we will compare diet use among three species of egrets that forage sympatrically in an ecosystem heavily impacted by HIREC.

Snowy egrets (*Egretta thula)*, tricolored herons (*Egretta tricolor)*, and little blue herons (*Egretta caerulea)* that reside in the Everglades have experienced a consistent and sharp decline in nest numbers over the past decade, due in part to food resource limitations. Wading bird food acquisition is strongly correlated to hydraulic conditions providing a pulse of available prey during the dry season, which triggers nesting. Due to a century of anthropogenic modifications in the Everglades, this dynamic system likely provides sub-optimal foraging habitat for wading birds. As a result, some wading birds may be utilizing more stable anthropogenic foraging habitats such as canals, which contain a higher percentage of non-native fishes than does the natural marsh. Despite morphological similarities among small herons, varying foraging strategies could enable one species to forage more successfully than another in anthropogenic habitats. As anthropogenic modifications continue to expand, this study will contribute to the growing body of literature aimed at understanding what mechanisms may enable certain species to thrive in the face of environmental change.

We measured the percent biomass of non-native prey items and the corresponding nesting success in three species of wading birds to determine how diet shift affects a species' response to HIREC. We predicted that nesting success is correlated with a greater diversity of prey species including non-native fishes. During the 2013-2016 nesting seasons, food boluses (stomach regurgitations) from snowy egrets, tricolored herons, and little blue herons were collected from three wading bird colonies in the Florida Everglades. We predicted that little blue herons, a diet generalist, would forage in canals more frequently than the other two species of small herons, diet specialists. Results showed that little blue herons, averaged nearly 26% non-native prey, compared to 14% and 5% for tricolored herons and snowy egrets, respectively. In contrast, the samples of available prey in the Everglades showed that <1% were non-native species, suggesting that wading birds were either highly selective for non-natives in the natural marsh or they were foraging in anthropogenic habitats where the proportion of non-native prey is higher. This is a key distinction that, once known, will affect the predicted responses of wading bird performance measures to CERP.

BIO: Ashley received her B.S. in wildlife biology from Colorado State University, after which she worked as a research coordinator, crew leader, and avian field technician in Wyoming, Montana and Alaska. Currently a master's student at Florida Atlantic University, her research is focused on small heron prey selection and nesting success.

Contact Information: Ashley Jackson, Florida Atlantic University, 777 Glades Road, Boca Raton, FL, USA 33431, Phone: 561-297-2597, Email: jacksona@fau.edu

TRACERS OF OM TRANSPORT IN FLOWING EVERGLADES WETLANDS, FROM MARSH TO ESTUARY

Rudolf Jaffé
Florida International University, Miami, FL, USA

The Everglades ecosystem will be increasingly influenced by hydrologic restoration projects aimed to improve water delivery, quality and timing. At the same time, this coastal wetland ecosystem will be subjected to sea-level rise (SLR) along the coastal ecotone, leading to two hydrologically opposed and competing processes affecting the biogeochemistry of the system. Among other parameters, organic matter (OM) generation, transport, distribution and fate will be impacted in complex ways affecting loading and accumulation; foodweb dynamics, landscape patterns, and carbon fluxes. As such a detailed understanding of OM dynamics in the Everglades is needed to predict potential impacts of restoration, management and climatic effects including SLR. However, constraining OM sources, transport and fate in an ecosystem of the complexity and size of the Everglades has proven to be a significant challenge. Here we present a variety of different quantitative and qualitative methodological approaches to the development and consecutive application of OM proxies to the Everglades, to assess environmental dynamics of dissolved organic matter (DOM) and particulate organic matter (POM) in an attempt to meet this challenge. Examples will be provided for the application of optical properties determinations (e.g. fluorescence measurements) to determine DOM source changes and transformations throughout the Everglades, applications of molecular biomarkers to assess re-mobilization, transport and deposition of POM in freshwater wetlands and the coastal ecotone, and the application of long- and short-term DOC measurements' modeling to better predict or anticipate future C-flux changes in Everglades estuaries as a result of new water management practices and climatic effects.

BIO: Dr. Jaffé is a Professor of Chemistry & Biochemistry and a faculty of the Southeast Environmental Research Center and Florida International University. He has been on the team of PIs of the Florida Coastal Everglades LTER program since 2000 and a participant on the SFWMD sponsored Decomp Physical Model project.

Contact Information: Rudolf Jaffé, Southeast Environmental Research Center, Florida International University, Miami, Fl., 33199. Phone: 305.348.2456; jaffer@fiu.edu.

USDA-ARS NATIONAL PROGRAM OVERVIEW OF BIOCONTROL OF WEEDS

Rosalind R. James
USDA Agricultural Research Service, Beltsville, MD, USA

Many of the toughest invasive plant problems are best solved with the use of biological control agents. Once developed, biological control is cheap to use, works in ecologically sensitive areas, and works well in difficult-to-reach areas. Biological control harnesses ecological processes, ousting invaders and giving a competitive advantage to natural ecosystems. The USDA Agricultural Research Service plays a critical role in the development of biological control programs for the United States. Four overseas laboratories are dedicated to identifying new natural enemies of invasive weed, such as insects that feed only on these plants. The natural enemies must be found in the native range of the invader. To assure only the safest, most effecting agents are brought into the United States for release, these laboratories work with other ARS laboratories in the United States, such as the Invasive Plant Research Laboratory in Ft. Lauderdale, FL. That laboratory is dedicated to development of biological control of weeds in Florida, helping to protect both private property and the unique natural resources of the state, such as the Florida Everglades. The Invasive Plant Research Laboratory has been instrumental in the development of many successful control programs in Florida, reducing the impact of some of Florida's worst invasive plant pests, such as melaleuca, water hyacinth, and air potato. With our collaborators, ARS researchers are currently well on the way to tackling other tough problems, such as salvinia, Brazilian pepperweed, and Chinese tallow.

The organizational structure and decision making process for determining biocontrol research priorities in ARS will be presented. ARS also coordinates efforts with other government agencies, such as the Animal and Plant Health Inspection Service (US-APHIS), U.S. Fish and Wildlife (US-FWS), and international biocontrol organizations, such as the Center for Agriculture and Biosciences International (CABI) and the Australians (CSIRO), as well as local governments and non-government entities. Safe and successful biological control takes a team of researchers to develop, and yet another team of people to implement. Although the process take time, the benefits are long lasting and well worth the effort.

BIO: Dr. James is the National Program Leader for Invasive Pests of Crops for the Agricultural Research Service (ARS), part of the U.S. Department of Agriculture. Dr. James oversees the coordination and implementation of ARS research across a broad program directed towards the control and prevention of invasive pests, including development of classical biological control programs for invasive plants.

Contact Information: Rosalind James, USDA-ARS Office of National Programs, George Washington Carver Center, 5601 Sunnyside Ave, Beltsville, MD, 20705. Phone: 301-504-4609, Email: Rosalind.James@ars.usda.gov

PHOSPHORUS FLUX IN THE EVERGLADES STORMWATER TREATMENT AREAS

***Mike Jerauld*[1]**, *Tom DeBusk*[1], *John Juston*[1], *Dawn S. Finn*[1], *Jill King*[2]
[1]DB Environmental, Inc., Rockledge, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

Removal of phosphorus (P) from runoff by the Stormwater Treatment Areas (STAs) protects the historically oligotrophic Everglades from anthropogenic eutrophication. The outflow concentrations in the STAs continue to improve, with total phosphorus (TP) concentrations reaching below 20 µg/L in some of the STAs. More efforts are needed to achieve the stringent regulatory TP limits of 13 µg/L (long-term) and 19 µg/L (annual). The concerted Restoration Strategies Science Plan seeks to fill gaps in the understanding of STA internal processes, to facilitate the achievement of target discharge concentrations. One ongoing component of the science plan is the identification and quantification of P fluxes in the STAs, particularly in the back-end regions where fluxes could have the greatest influence on outflow concentrations.

STA-2 Cell 3 is a well-performing, well-studied STA flow-way dominated by submerged aquatic vegetation. Using in situ flux chambers and porewater equilibrators, we measured the overall flux of P into surface water (“net” flux) and the porewater-surface water P concentration gradient (diffusive flux), respectively, into the water column at inflow, mid, and outflow regions of Cell 3. Net and diffusive flux rates measured under a range of P loading conditions displayed a longitudinal gradient, from inflow to outflow, similar in magnitude to that observed previously along the P enrichment gradient in northern WCA-2A. Estimated diffusive fluxes up to 0.5 $mg/m^2/d$ were a small fraction (5 – 15% at inflow, ~0% at outflow) of measured net flux (0 – 5 $mg/m^2/d$). Importantly, in the outflow region, diffusive fluxes have been persistently negligible or absent, yet positive net fluxes have been observed there. The influence of forcing factors including season and antecedent P loading rates remain under investigation. An understanding of the flux mechanisms contributing to the discrepancy between diffusive and net flux rates, which may be key controls on STA outflow concentrations, requires further investigation.

BIO: Mr. Jerauld’s research concerns the biogeochemical processes affecting water quality in treatment and natural wetlands. He has worked in wetlands around the state of Florida, and has been involved with Everglades stormwater treatment area research for eight years.

Contact Information: Mike Jerauld, DB Environmental, Inc., 365 Gus Hipp Blvd, Rockledge, FL, USA 32955, Phone: 561-801-2899, Email: mike@dbenv.com

LABORATORY ASSESSMENT OF HYDRAULIC PROPERTIES OF HETEROGENEOUS ORGANIC SOILS IN THE EVERGLADES

Anupama John *and Hector R Fuentes*
Florida International University, Miami, FL USA

Numerical simulations of soil processes use hydraulic parameters to define saturated and unsaturated flow distribution in a soil matrix. These parameters are better defined for mineral soils than for organic soils like peat. Previous studies that have characterized hydraulic properties of peat have shown large variability in hydraulic parameters from region to region, making it difficult to develop general acceptable ranges of parameters for numerically modeling peat hydrology. Furthermore, very little is known about the hydraulic properties of heterogeneous peat soils with organic matter at different degrees of decomposition and mixed soils of marl and peat commonly found in the Everglades.

The objective of this research was to characterize the hydraulic properties of soils sampled from freshwater marshes and sloughs with five dominant vegetation types: 1) broadleaf floating, 2) graminoid short, 3) sparse graminoid tall *Cladium jamaicense*, 4) medium graminoid tall *Cladium jamaicense*, and 5) tall graminoid typha. Laboratory tests were used to determine the hydraulic parameters of soils, and quantify the influence of organic content (OC), vegetation type, and fiber content (FC) on saturated hydraulic conductivity and water retention curves using statistical criteria.

The results from this study showed that the hydraulic conductivity of heterogeneous peat marl soils varied among sites with different vegetation types. For samples with OC less than 80%, an increasing second-order polynomial relationship with OC explained 79% of variation in hydraulic conductivity. Marl soil have very fine particle size resulting in lower hydraulic conductivity than peat, however, mixed soils had higher hydraulic conductivity than pure marl or pure peat soils, which may be explained by changes in pore-size distribution. For samples with OC greater than 80% (peat soils), an increasing linear relationship with FC explained 57% of variation in hydraulic conductivity. Change in volumetric water content due to air entry potential increased with organic content but no significant differences were observed at field capacity. For peat soils, porosity increased with FC, however, volumetric water content at all retention points decreased with increasing FC. This study concludes that the complex hydraulic behavior of heterogeneous organic soils could be predicted by fundamental soil physical properties like OC and FC. Additional sampling and testing is needed to further confirm the extent of the effect of degree of decomposition and degree of mixing marl and peat on the trends herein identified.

BIO: Anupama John is a Ph.D. candidate at the Department of Civil and Engineering at Florida International University. She received her M.S. in Civil Engineering with an emphasis on water resources from Florida International University. Her research focusses on the numerical modeling of water distribution and flow in unsaturated soil systems.

Contact Information: Anupama John, Department of Civil and Environmental Engineering, 10555 West Flagler Street, Miami, FL, USA 33174, Phone: 305-348-2522, Email: ajohn188@fiu.edu

NAVIGATING THE SCIENCE-POLICY BOUNDARY IN NATURAL RESOURCE MANAGEMENT

Fred A. Johnson[1]*, Mitch Eaton*[2]*, and Julien Martin*[1]

[1]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA
[2]U.S. Department of the Interior, Southeast Climate Science Center, Raleigh, NC USA

The boundary between science and policy traditionally has been seen as necessary so that expert knowledge can be identified and science can be protected from politicization. The science-policy boundary also exists because of world views, philosophies, and cultures that differ between the two domains. As a result, the approach to science and policy has tended to be contractual or consultative, where scientists conduct research that is handed off to managers, and then managers decide how to use the information to guide conservation efforts. Yet this model has been criticized since at least the 1970s, often evoking complaints from scientists that their research is neither used nor appreciated, and from managers that the science produced is not directly relevant to the problems they face. An alternative model is one in which science and policy are embedded in a collaborative model of conservation planning and practice, where research questions are sourced from decision makers, policy alternatives are treated as hypothesis-driven experiments, and where active communication, perspective sharing, and different forms of knowing facilitate joint problem solving. A growing body of evidence suggests that the gap between science and policy can be bridged most effectively by boundary organizations (or individuals) that act as intermediaries between scientists and decisions makers by serving as honest brokers. We propose that boundary organizations can be effective in this role by using applied decision science to collaboratively engage conservation practitioners in defining the decision problem(s), specifying alternative policy choices, understanding the inevitable tradeoffs in meeting management objectives, and identifying key uncertainties that can be reduced through an integrated program of research and management.

BIO: Dr. Johnson is a Research Wildlife Biologist at the United States Geological Survey's Wetland and Aquatic Research Center. He has over 25 years of experience in the application of decision science to problems in natural resource management.

Contact Information: Fred A. Johnson, USGS Wetland and Aquatic Research Center, 7920 NW 71st Street, Gainesville, FL 32653; Phone: 352-264-3488, Email: fjohnson@usgs.gov

WATER STORAGE FEATURES IN THE COMPREHENSIVE EVERGLADES RESTORATION PLAN (CERP) – ORIGINAL GOALS AND CURRENT STATUS

***Robert Johnson**, and Kevin Kotun*
National Park Service, Everglades National Park, FL, USA

The adverse impacts of wetland losses in the Everglades have been documented since the 1940's. A major goal of Everglades restoration is to redirect harmful discharges away from the northern estuaries, by re-establishing water flows from Lake Okeechobee into the central and southern Everglades but these improvements are dependent on new water storage. The Everglades restoration goal to "Get the Water Right", calls for 1.8 million acre-feet of new surface water storage by 2036, and capacity to store 1.7 billion gallons per day in below ground storage by 2030 (Strategy and Biennial Report, 2016).

While a number of key pre-CERP and CERP restoration projects have been advancing, and we are starting to see on-the-ground ecosystem benefits, progress on achieving these water storage goals has been slow. In addition, dam safety concerns with the 1920's era Herbert Hoover Dike around Lake Okeechobee have led to a substantial reduction in wet season lake stages, which has reduced available water storage compared to what was originally envisioned in CERP. Increased water storage in the Everglades is critical to buffering both the natural and built ecosystems from the detrimental effects of frequent floods and droughts, and is even more important as we look for opportunities to increase the system's resilience to climate change.

More than 1.2 million acre-feet of new surface water storage was envisioned in the CERP. Surface water storage is important for rapid removal of stormwater runoff, but provides less carry-over drought protection than below ground storage. Two large above ground reservoirs in the Caloosahatchee and St. Lucie basins are moving forward, and are expected to produce approximately 120,000 acre-feet of new storage for local basin runoff. While a large (200,000 ac-ft) above ground reservoir is being considered in the current Lake Okeechobee Watershed Plan, storage in the Upper East Coast has been scaled back (from 350,000 ac-ft to 110,000 ac-ft), and the reservoir planned for the Everglades Agricultural Area (360,000 ac-ft) has no planned construction before 2035. New surface water reservoirs that are planned to date therefore account for approximately 30-40 percent of the original CERP storage goal. Three in-ground storage reservoirs, with a total capacity of 325,000 acre-feet, were also planned in CERP to capture wet season runoff, with greater potential for longer-term drought protection. Unfortunately one reservoir has been re-purposed to improve water quality treatment, while the other two Lakebelt reservoirs do not appear to be feasible. Aquifer storage and recovery (ASR), the largest single water storage component in CERP, has also been scaled back to approximately 40 percent of the assumed inflow/outflow capacity due to hydro-geologic limitations.

The potential loss of over 1 million acre-feet of new CERP storage, combined with a >500 ac-ft reduction of Lake Okeechobee storage, raises significant concerns for our ability to achieve the planned benefits for both the natural and built ecosystems. These storage changes will need to be closely evaluated as Everglades restoration progresses, particularly in light of climate change projections for South Florida.

BIO: Robert Johnson is a supervisory hydrologist, and the Director of the South Florida Natural Resources Center, with more than 30 years of experience planning, designing, and implementing Everglades natural resources preservation and restoration projects.

Contact Information: Robert Johnson, South Florida Ecosystem Office, 950 North Krome Avenue, Homestead, FL, USA, 33030, Phone: 305-224-4200, Email: robert_johnson@nps.gov

STRATEGIC COMMUNICATION OF THE NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE: EVERGLADES STUDIES AND BEYOND

Stephanie Johnson
National Academies of Sciences, Engineering, and Medicine, Washington, DC, USA

The National Academies of Sciences, Engineering, and Medicine has been providing scientific advice on Everglades restoration since 1999. The Academies appoints committees of experts who volunteer their time to examine issues, typically at the nexus of science and policy, and provide consensus reports on their findings. The National Academies strives for strong communication and outreach that includes dynamic public engagement and a portfolio of products to meet its audiences' needs. Although consensus reports are the central products of the Academies study process, additional communication efforts for Everglades studies include a study website, reports-in-brief, and webinars, generally targeted to interested stakeholders and decision makers. The National Academies are continuing to explore opportunities to enhance its communications efforts through increased use of social media, video, and webinars. Communication is a central consideration at the start of each study, and a committee's early tasks include determining their target audiences. Additionally, Academies staff work to build the audience for the report throughout the study process. Many studies also include dedicated funding for communication efforts after the release of a report, including videos, booklets, or workshops, to expand the reach of the reports to different audiences and help stakeholders begin to implement the findings.

BIO: Stephanie Johnson is a senior program officer with the National Academies of Sciences, Engineering, and Medicine, who has served as study director for all six biennial reports of the Academies' Committee on Independent Scientific Review of Everglades Restoration Progress.

Contact Information: Stephanie Johnson, 500 Fifth St. NW, Washington, DC 20001; Phone: 202-334-3385; Email: sjohnson@nas.edu.

IMPACT OF SEA-LEVEL RISE ON EVERGLADES CARBON STORAGE CAPACITY

Miriam C. Jones*, Christopher Bernhardt, G. Lynn Wingard, Bethany Stackhouse*
U.S. Geological Survey, National Center, Reston, VA, USA

The Holocene history of South Florida has been shaped by climatic changes that have impacted sea level, sedimentation, and biological processes. The Florida Everglades comprise most of the undeveloped portions of South Florida, providing valuable habitat and water resources for wildlife, and acting as a significant carbon (C) sink. Everglades National Park includes Florida Bay, a shallow carbonate bay that is subdivided by carbonate islands and mudbanks that formed over the last few thousand years and once comprised the freshwater Everglades. These islands are often ringed with mangrove forests, providing additional habitat and physical barriers to storm surge, tidal flux, and wave development. With most of South Florida located between 1-2 m above mean sea level, and IPCC AR5 projections of 0.26 to 0.98 m of sea-level rise by 2100, vertical accommodation space is expected to outpace sediment accumulation in parts of the coastal freshwater Everglades, as well as the islands and mudbanks in Florida Bay. This would not only impact valuable wildlife habitat, habitable land for human populations of South Florida, and protection of shorelines from coastal storms, but also alter carbon feedbacks to climate warming.

In order to study the impact sea-level rise has on carbon dynamics in these coastal wetland and marine environments, we collected sediment cores from 4 islands in Florida Bay. The cores were collected from the interior playa-like environments, which flood occasionally with sea water that subsequently evaporates, creating a hyper-saline environment that is hostile to most life. Many of the interior playa-like basins are situated below sea level, suggesting sediment accumulation is slow. Each core recovered 200-250 cm of sediment before bottoming out in limestone bedrock. We used pollen and mollusk assemblages, stable isotopes of carbon, and C/N ratios to interpret how floral and faunal communities and source carbon changed in response to Holocene sea level transgression. Radiometric dating, bulk density, and organic carbon content were used to calculate changes in C accumulation rates over the last ~4000 years, as deposition transitioned from freshwater peat to brackish and marine carbonate mud and mangrove peat to ultimately the hyper-saline interior playa carbonate mud, similar to sediments being deposited today. Based on pollen and $\delta^{13}C$ and C/N ratios of the organic fraction of these sediments, C accumulation rates are more than twice as high in the basal freshwater Everglades peat than in the sediment deposited in the brackish/marine environment that followed. The freshwater Everglades C accumulation rates are also slightly higher than during the short-lived period of mangrove peat accumulation. The post-mangrove playa-like environments have C accumulation rates on par with the brackish and marine carbonate mud accumulation, and stable isotope and C/N ratios suggest the majority of this carbon originates from a combination of sea grass and algal mats. These results suggest that the C storage capacity of the Florida Everglades will decrease significantly if the freshwater Everglades peat accumulation cannot outpace sea-level rise, but that establishment of mangrove forests could offset much of the carbon loss, as long as they are able to keep pace with future rates of elevated sea-level rise.

BIO: Dr. Jones has been researching the role of wetlands in the global carbon cycle for almost 10 years and has been working in Florida wetlands for the last 4 years. Her interests are primarily focused on using paleoecological proxies to study the impact of climate and environmental change on long-term carbon accumulation rates.

Contact Information: Miriam Jones, Eastern Geology and Paleoclimate Science Center, USGS, 12201 Sunrise Valley Dr., MS 926A, Reston, VA, USA 20192; Phone: 703-648-6936; Email: Miriamjones@usgs.gov

KEY FACTORS CONTROLLING WETLAND AQUATIC PRODUCTIVITY IN THE EVERGLADES STORMWATER TREATMENT AREAS

***Paul Julian II*[1,2]**, *Matthew Powers*[3], *Rupesh Bhomia*[4], *Alan Wright*[1], *Jacob Dombrowski*[3]

[1]University of Florida, Soil and Water Sciences, Ft. Pierce, FL, USA
[2] Florida Department of Environmental Protection, Office of Ecosystem Projects, Ft. Myers, FL, USA.
[3]South Florida Water Management District, Water Quality Treatment West Palm Beach FL, USA
[4]University of Florida, Soil and Water Sciences, Gainesville, FL, USA

Aquatic productivity, including gross primary productivity (GPP), respiration (R) and net aquatic productivity (NAP) provides a useful composite indicator of ecosystem function in wetlands. Productivity is limited by light, nutrient availability and hydrologic dynamics in wetlands systems. In riparian wetlands, hydrologic pulsing has been demonstrated to either positively or negatively affect aquatic productivity by influencing other ecosystem processes (e.g. nutrient uptake, photosynthesis, respiration and reproduction rates of aquatic producers and consumers, etc.). In lake and wetland ecosystems, allochthonous carbon drives aquatic productivity resulting in supersaturation of carbon dioxide, high bacterial productivity and high secondary productivity.

High-frequency measurements of dissolved oxygen, temperature, pH and specific conductance were collected using in situ probes in select treatment wetlands in the Everglades basin. This information was used in combination with the ambient weather data to assess GPP, R and NAP in Stormwater Treatment Area (STA) 2 Cell 1 (emergent aquatic vegetation) and Cell 3 (submerged aquatic vegetation). Additional water samples were collected during the sonde deployments for determination of total phosphorus, soluble reaction phosphorous, total nitrogen, nitrate-nitrite and dissolved organic carbon in the surface water. These data were used to determine controlling factors of aquatic productivity in two different wetland vegetation communities during control flow experiments. Changes in flow regime, differences in vegetation communities and nutrient availability significantly influenced aquatic productivity at the monitoring locations along these wetlands.

This study provides an insight into existing water column biogeochemistry and could provide process related information on wetland biogeochemistry and phosphorus retention. Furthermore, this information is valuable with respect to STA treatment efficiency and provide a crucial understanding in meeting the expected outflow water quality goals of the STAs.

<u>BIO</u>: Mr. Julian is a PhD student with the University of Florida Soil and Water Sciences Department, in the Wetland Biogeochemistry Laboratory studying wetland biogeochemical processes specific to the Everglades ecosystem and stormwater treatment areas, wetland nutrient spiraling and aquatic productivity.

<u>Contact Information</u>: Paul Julian II, Wetland Biogeochemistry Laboratory, Soil and Water Sciences Dept., University of Florida, Fort Pierce, FL, 34945. Email: pjulian@ufl.edu

LIMITING FACTORS IN MERCURY METHYLATION HOTSPOT DEVELOPMENT: THE TANGLED WEB

***Paul Julian II*[1,2]**, *Binhe Gu*[3], *and Alyssa Freitag*[1]

[1]Florida Department of Environmental Protection, Office of Ecosystem Projects, Ft. Myers, FL, USA.

[2]University of Florida, Soil and Water Sciences, Ft. Pierce, FL, USA

[3]South Florida Water Management District, Water Quality Bureau, West Palm Beach FL, USA

Mercury (Hg) methylation and bioaccumulation is a major environmental issue in the Greater Everglades Ecosystem. Mercury has been recognized as a major ecological concern since the late 1970s when elevated concentrations were observed in fish and other biota within the Everglades Ecosystem. Areas of elevated Hg concentrations in fish, soil and water can be found through the Everglades system. These areas have been operationally defined as hotspots confirmed by historic data and action level criterion such as soil threshold effects level and piscivorous avian protection guidelines and have persisted in the system regardless of upstream water quality improvements. Sulfate has been hypothesized to control Hg methylation in soils within the Everglades Ecosystem based on a hypothesized unimodal relationship. However, this relationship with the Everglades between sulfate and methyl-Hg (MeHg) is highly spatially and temporally variable and not consistent with the hypothesized unimodal Sulfate-Hg relationship. Therefore, suggesting that other biogeochemical factors are involved with Hg methylation, uptake and transport.

Based on the weak relationship between sulfate and MeHg, it is possible that other biogeochemical interactions are occurring which regulate Hg methylation and availability. Iron has been demonstrated to influence sulfur cycling patterns which if linked to Hg methylation could influence the Hg methylation cycle. Dissolved organic matter has also been identified to play a crucial role in Hg methylation and availability. The cycling of Hg is ultimately regulated in-part by the availability of Hg. The primary source of Hg to the Everglades ecosystem is by atmospheric deposition at a rate of 10-21 µg Hg m-2 yr-1. Meanwhile, secondary deposition via litterfall can span an order of magnitude at a rate of 1 – 109 µg Hg m-2 yr-1. Therefore, Hg source dynamics within the Everglades ecosystem is a combination of new Hg from direct bulk deposition into the system (i.e. soil, vegetation and water) and old Hg from litterfall. As Hg enters the biogeochemical cascade several interactions (i.e. vegetation dynamics, microbial interactions etc.) combined with in-situ biogeochemical cycling results in the Hg methylation and even de-methylation. Factors responsible for demethylating Hg via demethylating microbes could also play a very important and often overlooked role in methylating Hg.

This presentation will discuss factors that influence Hg methylation within the Everglades ecosystem, potential drivers in hotspot formation and the biotic controls of Hg cycling.

BIO: Mr. Julian is the Everglades Technical Lead with the Department of Environmental Protection Office of Ecosystem Projects where he is involved with water quality aspects related to Everglades restoration and works cooperatively with local, state and federal partners.

Contact Information: Paul Julian II, Florida Department of Environmental Protection Office of Ecosystem Projects, Fort Myers, FL 33902. Email: paul.julian@dep.state.fl.us

ST. LUCIE ESTUARY AND INDIAN RIVER LAGOON: EXAMINING SEAGRASS SPECIES COMPOSITION COUPLED WITH FLOW RATES AND SALINITY

***Amanda Kahn Dickens**, Rebecca Robbins, Beth Orlando, Barbara Welch, Zhiquiang Chen*
South Florida Water Management District Applied Science Bureau, West Palm Beach, FL, USA

This study examined seagrass species composition at two sites in the St. Lucie River Estuary portion of the Indian River Lagoon system: Willoughby Creek and Boy Scout Island. Quarterly to monthly monitoring of seagrass has been conducted at these two sites since 2008. This seagrass data set was examined for changes in seagrass species composition over time and coupled with average 28-day flows from Lake Okeechobee, C44, S48, S49, GC, and the total basin for the associated time periods when seagrass monitoring occurred. An YSI data sonde measuring salinity and temperature was deployed at depth at each site, recording parameters every 15 minutes. Degree of variation in salinity over time was assessed and salinity extremes over a 28-day time period were examined as related to the frequency that salinity was outside the salinity optimum for each of the prevalent seagrass species: *Syringodium filiforme* (manatee grass), *Halophila johnsonii* (Johnson's seagrass), and *Halodule wrightii* (shoal grass). Utilizing the degree of variation and duration of extremes as parameters can help determine how degree and duration of flow affect the system. Multi-dimensional scaling was used to visualize the data sets to determine similarities in conditions of changing seagrass population structures in conjunction with the environmental parameters with the time period of seagrass species composition data collection. Further non-parametric analyses were utilized to determine if salinity can be utilized as the driving environmental factor shaping seagrass structure, or if other factors altered by freshwater flow into the system, such as light environment, better predict seagrass responses.

BIO: Dr. Kahn Dickens, Senior Scientist for SFWMD, has 15 years of research experience from Indian River Lagoon to Florida Keys, specializing in plant physiology and marine chemistry. Her investigations focus on light, salinity, and nutrient effects on photosynthesis of seagrass, seaweed, coral, and phytoplankton and resulting ecological implications.

Contact Information: Amanda Kahn Dickens, PhD, South Florida Water Management District Applied Science Bureau Coastal Ecosystems Section, 3301 Gun Club Road, West Palm Beach, Florida, USA 33406, Phone: (561) 682- 6402, Email: adickens@sfwmd.gov

STRUCTURAL MICROHABITAT UTILIZATION OF THE INVASIVE CUBAN BROWN ANOLE *(ANOLIS SAGREI)* IN A NATURALIZED HABITAT OF SOUTH FLORIDA

***Frank Kahoun* [1,2]** *and Rachel Thiet*[2]
[1]Quest Ecology, Tamarac, FL, USA
[2]Antioch University New England, NH, USA

The Cuban brown anole *(Anolis sagrei)* is an introduced species that has spread throughout most terrestrial habitat types in South Florida; however, limited studies have documented structural microhabitat utilization within naturalized and novel habitats in South Florida. In its native habitat on the islands of Cuba and the Bahamas, *A. sagrei* utilizes the structural microhabitat of the lower trunk of trees and the immediate understory, while other structural microhabitats are utilized by multiple intrageneric competitors. In contrast, South Florida has less intrageneric competition for *A. sagrei*. Additionally, multiple sources have associated invasive *A. sagrei* populations with local extirpation of the native Anolis carolinensis. By better understanding how introduced and invasive species are expanding their habitat utilization in naturalized habitats, ecosystem managers will be able to make more informed management decisions to protect native species and regional biodiversity.

In this study, *A. sagrei* behavior was observed and documented in situ to characterize structural microhabitat utilization in a disturbed, upland habitat in Broward County, Florida. Microhabitat utilization was recorded in two categories: the trunk-ground ecomorph assignment (the documented microhabitat of *A. sagrei* in its natural habitat) and all other ecomorph assignments. A t-Test was used to compare observed structural microhabitat utilization by category to determine if utilization outside of the traditional trunk-ground ecomorph category constitutes a significant component of overall *A. sagrei* habitat utilization.

Although *A. Sagrei* were observed outside of the structural microhabitat associated with the trunk-ground ecomorph, our results suggest that the upper trunk and canopy, the habitat of *A. carolinensis*, is not a significant portion of *A. Sagrei* habitat utilization. The results of this study do not support the conclusions of previous studies that have associated invasive A. sagrei with the extirpation of *A. carolinensis* due to direct competition for habitat. More research is needed to understand the relationship between intrageneric completion and Anolis population densities in South Florida.

BIO: Frank Kahoun is a PhD student at Antioch University New England and a senior environmental scientist with Quest Ecology. He is currently working on the Tamiami Trail Next Steps Project, a 3.2 mile project with the goal of restoring historic hydrologic connectivity in the southern Everglades.

Contact Information: Frank Kahoun, Quest Ecology, Suite 220, 6635 W. Commercial Blvd.Tamarac, FL 33319, Phone: 954-2 90-8223, Email: Frank@Questecology.com

EVERGLADES R-EMAP PHASE IV 2014: IMPLICATIONS FOR MERCURY METHYLATION AND BIOACCUMULATION

***Peter Kalla*[1]**, *Daniel Scheidt*[2], *Anthony Carroll*[1], *Pamela Betts*[1], *Pedro Lorenzo*[3], *Guangliang Liu*[3], *and Yong Cai*[3]
[1]U.S. Environmental Protection Agency, Region 4 Laboratory, Athens, GA, USA
[2]U.S. Environmental Protection Agency, Region 4 Water Protection Division, Athens, GA, USA
[3]Florida International University, Southeast Environmental Research Center, Miami, FL, USA

Prior to the 2014 REMAP wet season survey, discharge from the Everglades Agricultural Area into the public Everglades was down markedly compared to the previous survey in 2005. This decline led to lower water levels when the survey was conducted. We found significantly less sulfate and methyl mercury in surface water, and significantly less total mercury in mosquitofish (*Gambusia holbrooki*).

Only the nutritional status and methyl mercury content of benthic periphyton appeared to be directly correlated to mosquitofish mercury, suggesting that the fish were exposed to mercury by preferentially consuming benthic periphyton, or by consuming herbivores that fed on it. Given the generally widespread and precipitous drop in mosquitofish mercury levels in 2014, the data may simply not be variable enough to produce the strong relationships observed in 2005.

Methyl mercury in surface water was weakly correlated with dissolved organic carbon (DOC) and sulfate, and not with total phosphorus in water. Methyl mercury in benthic periphyton was also correlated with DOC, and with total organic carbon in water. Methylation of mercury could occur within benthic periphyton, or at the soil-water interface immediately below it, where organic carbon, sulfate, and reducing conditions can be present together. With low discharge into the system in 2014, meaning less carbon and sulfur in the environment, benthic periphyton may have been the only place where significant amounts of methylated mercury were available in the food web.

Total phosphorus in soil was unchanged. It was moderately inversely correlated with benthic periphyton thickness, water column periphyton volume, and periphyton cover. It was also weakly inversely associated with floc thickness. These relationships indicate the negative effect of elevated soil phosphorus on the native ridge and slough community. This diverse community is dominated by periphyton in the sloughs and by moderately dense, moderately tall sawgrass on the ridges. Where excessive phosphorus has accumulated in the soil, the native community has been replaced by tall, dense sawgrass and cattail. Such habitats have periphyton largely excluded and have less aquatic food web diversity and food chain length. REMAP data show that parts of the Everglades with high phosphorus and sulfur may favor mercury methylation, but that they may also have food webs that are sufficiently degraded by these pollutants so as to inhibit mercury bioaccumulation. The remaining mercury hotspots represent places in the landscape where both processes are enhanced.

BIO: Dr. Kalla is a wetland and watershed ecologist with 25 years of experience planning, implementing, and interpreting Everglades REMAP and other probabilistic assessments of large aquatic ecosystems.

Contact Information: Peter Kalla, U.S. EPA Science and Ecosystem Support Division, 980 College Station Rd., Athens, GA, USA 30605, Phone: 706-355-8778, Email: kalla.peter@epa.gov

FLORIDA BAY 2015 SEAGRASS DIE-OFF: EXTENT AND CHARACTERISTICS

***Christopher Kavanagh**, Vicki McGee-Absten, Zachary Fratto, Matt Patterson, Michelle Tongue*
Everglades National Park, Key Largo, FL, USA

The summer of 2015 in Florida Bay saw extensive mortality of *Thalassia testudinum* seagrass similar to the massive mortality event from 1987-1991. Localized rainfall deficit, meteorological and biological conditions, acute hypersalinity, hypoxia and elevated sulfide levels combined to affect the die-off of a large area of seagrass in north-central Florida Bay. Aerial and in-water efforts delineated the extent of the primary mortality. The previous *Thalassia* die-off spanned several years, with the primary die-off followed by secondary losses due to large-scale, persistent algal blooms that reduced light penetration in Florida Bay. Chlorophyll-a levels since the 2015 die-off have been monitored to describe a possible repeat occurrence of the ecological shift to a phytoplankton-dominated system in Florida Bay, as was reported in the 1990's. This presentation will discuss the current conditions and status of Florida Bay in Everglades National Park.

BIO: Christopher Kavanagh is a marine ecologist with National Park Service at the Florida Bay Interagency Science Center in Key Largo, Florida. Previously, Christopher was a research scientist with the Florida Institute of Technology for 15 years. He has been involved with various projects including seagrass, macro-algae and marine benthic recruitment.

Contact Information: Christopher Kavanagh, Everglades National Park, 98630 Overseas Highway, Key Largo, FL, USA 33033, Phone: 786-650-5069, Email: Christopher_kavanagh@nps.gov

SEEING THE FOREST THROUGH THE DEAD SEAGRASS: RESPONSE OF FLORIDA BAY FISH SPECIES TO SEAGRASS DIEOFFS, SALINITY, AND OTHER ENVIRONMENTAL FACTORS

***Christopher Kelble*[1]**, *Lindsey Visser*[1,2], *Joan Browder*[3]
[1]NOAA Atlantic Oceanographic and Meteorological Laboratory, Miami, FL, USA
[2]University of Miami, Miami, FL USA
[3]NOAA Southeast Fisheries Science Center, Miami, FL, USA

Juvenile and small adult fish have been monitored in Florida Bay using the same method since the mid-1980s. These samples were collected intermittently until 2004, when this monitoring became routine sampling conducted as part of the RECOVER Monitoring and Assessment Plan. This consistent sampling has yielded many insights into how these fish species respond to environmental factors, including temperature, salinity, and seagrass. Much of our analyses have focused on just a few fish species based upon their economic importance as a recreational and/or commercial fishery, their relevance as an estuarine indicator, importance as a prey species, and sensitivity to predicted changes expected to be observed as Everglades restoration proceeds. In particular, Juvenile spotted seatrout have been adopted as a CERP Performance Measure. Juvenile Spotted Seatrout live their entire lives within Florida Bay, are a well established indicator of estuarine health, show significant responses to salinity both in the laboratory and in Florida Bay, and are an important recreational sportfish in Florida Bay. Up until 2015-2016, it was uncertain how the fish community in Florida Bay responded to seagrass dieoffs, since there was a multi-year break in sampling when the last seagrass dieoff occurred in the late 1980s.

Coincident with the seagrass dieoff in 2015, we observed 2 fish dieoffs and received unconfirmed reports of a third. In July 2015, we observed a significant die-off of toadfish in Rankin Lake, where the seagrass dieoff began and where extreme temperature and salinity measurements were observed at this same time. Toadfish may have been affected, because they are not as motile as other species and are more closely associated with the benthos; thus their stress response may have been to “shelter-in-place” making them more susceptible to the high temperatures and salinities, and low oxygen. The second dieoff was reported to involve pinfish in September 2015 in the same area of Rankin Lake. The third dieoff we observed in October 2015 involved a large number of mullet in the basin immediately south of Rankin Lake.

Despite, these dieoffs in 2015; the juvenile spotted seatrout population rebounded quickly in 2016. In fact, juvenile spotted seatrout were more abundant than in any year since 2007. This signaled the first high recruitment year for juvenile spotted seatrout in nearly a decade and indicated that the loss of seagrass did not negatively affect this species to the degree we had anticipated based on the statistical relationship between juvenile spotted seatrout frequency and seagrass percent cover. Current investigations are attempting to identify why 2016 was a good year for juvenile spotted seatrout despite the recent seagrass dieoff and lower coverage of seagrass. Results from these investigations will be presented to provide insights into how the seagrass dieoff affected a key fish indicator species in Florida Bay.

BIO: Dr. Kelble is a research oceanographer and deputy director of the Ocean Chemistry and Ecosystems Division at NOAA’s Atlantic Oceanographic and Meteorological Laboratory. He leads multiple projects investigating how Everglades Restoration will affect the coastal ecosystem. These projects investigate everything from water quality to fish to ecosystem services.

Contact Information: Christopher Kelble, NOAA Atlantic Oceanographic and Meteorological Laboratory, 4301 Rickenbacker Causeway, Miami, FL, USA 33149, Phone: 305-361-4330, Email: Chris.Kelble@noaa.gov

FECAL INDICATOR BACTERIA (FIB) AND BEACH MANAGEMENT POLICIES

***Elizabeth Kelly*[1,2,3]**, *Helena Solo-Gabriele*[1,2,3], *Ad Reniers*[3,4], *Zhixuan Feng*[3,5], *Allison Donahue*[2,3,6], *Hannah Lockwood*[2]

[1]Abess Center for Ecosystem Science and Policy, University of Miami, Coral Gables, FL, USA
[2]University of Miami Department of Civil, Architectural and Environmental Engineering, Coral Gables, FL, USA
[3]Center for Oceans and Human Health, Rosenstiel School for Marine and Atmospheric Science, Key Biscayne, FL, USA
[4]Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, 2628CN, The Netherlands
[5]Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA, USA
[6]Department of Biology, University of Miami, Coral Gables, FL, USA

Long-term datasets are available from beach water quality monitoring programs. Frequently, when these monitoring programs identify poor water quality, the causes are unknown, making it difficult to remove contamination sources. One approach would be to develop beach management policies that would help minimize the occurrence of contamination spikes.

The objective of this study was to evaluate associations between beach water quality and beach management policies to assess approaches that minimize exceedances of fecal indicator bacteria (FIB).

To address this objective, a survey was conducted to document beach management approaches for 316 beaches throughout the state of Florida. These results were analyzed to identify associations with FIB data (enterococci and fecal coliform). Part I evaluated county sampling and analysis policies and Part II examined beach management policies at the individual beaches. Beaches were also evaluated and classified by geomorphologic type.

Results show that beach geomorphology is highly associated with exceedance of regulatory standards. For open-coast beaches (n=211), low enterococci levels were associated with sparse human densities, no homeless populations, low densities of dogs and birds, beaches with bird management policies, low densities of seaweed, those that are renourished, charge access fees, with lifeguards, beaches without nearby marinas, and those that manage storm water. Fecal coliform resulted in fewer regulatory exceedances; lower fecal coliform levels were more strongly associated with the presence of public restrooms. Through the process of collecting beach management data, it became clear that multiple agencies are charged with beach management tasks and these agencies tend to work independently, making it difficult to comprehensively develop policies that would lower FIB levels. These results support that beach management policies influence FIB levels and that beach geomorphology should be considered when making beach policy decisions, along with a unifying set of standards for beach management recommended here. Future work emphasizing the impact of rivers and other freshwater bodies, in particular the role of discharges from Lake Okeechobee to estuaries including the St. Lucie and Caloosahatchee Rivers, along with Florida Bay, is also strongly recommended.

BIO: Elizabeth Kelly is a fourth-year doctoral student at the University of Miami's Abess Center for Ecosystem Science and Policy. Her goal is to evaluate water quality inland and at the beaches to explore the relationship between inland nutrient contributions and fecal indicator bacteria (FIBs) in rivers, canals, estuaries/bays, and beaches.

Contact Information: Elizabeth Kelly, University of Miami Leonard and Jayne Abess Center for Ecosystem Science and Policy, 1365 Memorial Drive, Ungar Building 2nd Floor, Suite 230F Coral Gables, FL USA 33146, Phone: 786-210-6279, Email: ekelly@umiami.edu

HYDROLOGIC AND WATER QUALITY MODELING FOR EVALUATING BEST MANAGEMENT PRACTICES IMPLEMENTATION IN A WESTERN EVERGLADES WATERSHED

***Yogesh Khare**, and Melodie Naja*
Everglades Foundation, Palmetto Bay, FL, USA

The Everglades is an ecologically unique and complex system where societal and political conflicts have added to technical challenges faced by water resource engineers and managers in south Florida. The Feeder Canal Basin (FCB), located in the Hendry County draining ~ 108 sq. miles of predominantly agricultural and natural land into Water Conservation Area 3A (WCA-3A) through the L-28 Interceptor Canal, is a good example of such a complex system. During the last five years, the monitoring data at the basin's outlet structure (S190) showed that FCB has been the highest phosphorus contributor to WCA-3A in terms of concentration, with the average of ~ 87 ppb flow weighted mean concentration. The aim of this study is to model water quality in FCB for the existing conditions in order to identify areas with the highest phosphorus contribution to the nearby waterbodies. To establish the baseline conditions, the Watershed Assessment Model (WAM) was calibrated (2000 -2004) and validated (2005-2014) for the monthly flows (Flow) and Total Phosphorus Load (TPL) at the S190 structure. Then three types of agricultural and urban Best Management Practices (BMP) (types I, II and III) were modeled and simulated for the entire period of interest (i.e. 2000-2014) to assess TPL reductions. Two goodness of fit (GOF) measures namely Nash-Sutcliffe Efficiency (NS) and Percentage Bias (PBIAS) were used for the baseline model evaluation. The NS values for the calibration period were 0.70 and 0.68 for Flow and TPL, respectively while the corresponding PBIAS values were 8.4% and 12.1%. The NS values for the validation period were 0.70 and 0.66 for Flow and TPL, respectively while the corresponding PBIAS were -9.3% and -10.0%. The GOF results indicated that the FCB WAM performance can be classified between 'Satisfactory' to 'Very Good'. The TP spatial distribution maps showed that row crops, groves and orchards had the highest TP concentration in their runoff while row crops and improved pastures contributed the most to TPL. Moreover, results of this study indicated that an average annual TPL of ~8 tons at S190 structure can potentially be reduced by 34, 42, and 53% under Type I, Type II and Type III BMP implementation, respectively. Agricultural and urban BMP implementation has been identified as one of the major environmental restoration strategies used in other parts of Florida and should be considered during the Western Everglades Restoration Project planning process recently initiated by the state and federal agencies.

BIO: Dr. Khare works at the Everglade Foundation as an environmental Engineer. He is applying his diverse background in civil, coastal and agricultural engineering for assessing effectiveness of various restoration strategies through hydrologic and water quality modeling.

Contact Information: Yogesh Khare, Everglades Foundation Inc., 18001 Old Cutler Road, Palmetto Bay, FL, USA 33157, Phone: 484-560-5160, Email: ykhare@evergladesfoundation.org

EVALUATION OF OPTIONS FOR SENDING MORE WATER TO FLORIDA BAY VIA TAYLOR SLOUGH USING REGIONAL SIMULATION MODEL FOR THE EVERGLADES AND LOWER EAST COAST

Fahmida Khatun*, Raul Novoa, Walter Wilcox, Tibebe Dessalegne and Harold Hennessey-Correa*
South Florida Water Management District, FL, USA

Florida Bay is the southernmost portion of America's Everglades ecosystem located in Everglades National Park (ENP). This 1,000-square-mile bay is one of the largest seagrass meadows in the world. Everglades' ecosystem, including Florida Bay was historically hydrated by direct rainfall and sheet flows from Lake Okeechobee. Direct rainfall over the bay accounts for more than 45 percent of its freshwater with today's highly managed Everglades system. Taylor Slough, located in the southeastern part of the ENP, is also a significant source of freshwater flows into sections of the bay.

Due to the drought in 2015, portions of Florida Bay experienced hyper salinity and vast seagrass die off. As a result of the 16-month long rainfall deficit in the area, the salinity in parts of Florida Bay rose to twice the salinity of ocean water. In an effort to help improve conditions in Florida Bay, the South Florida Water Management District (SFWMD) developed an innovative plan to deliver additional fresh water to Taylor Slough. The plan, fully implemented, will result in immediate improvement of flows to Florida Bay and function in tandem with ongoing efforts to implement larger Everglades restoration projects for the benefit of the bay.

The plan for Florida Bay was developed utilizing extensive modeling work done for the South Dade Study, a public process to address concerns related with agricultural flood control in southern Miami-Dade County while simultaneously sending much-needed water to natural areas. The Regional Simulation Model for the Everglades and Lower East Coast (RSMGL), a hydrologic model developed and implemented by SFWMD, was used to evaluate the project benefits. RSMGL, an implementation of the Regional Simulation Model (RSM; SFWMD, 2005a and 2005b), is a tool that simulates the natural hydrology and the water management operations of south Florida. The RSM is a robust and complex regional scale modeling tool that utilizes an implicit, finite-volume, distributed, and integrated surface-water and ground-water framework. This modeling tool simulates one-dimensional canal flow and two-dimensional overland and groundwater flow using physically-based numerical formulations with a variable triangular mesh. This tool is capable of evaluating potential operational alternatives to address issues in south Florida's regional system. With the operational improvements in the Florida Bay Project, modeling result shows that the plan will increase the flow of water directly into Taylor Slough by sending an average of 50% more fresh water per year.

BIO: Fahmida Khatun is the Interagency Modeling Center Program Manager of the SFWMD. She is an Engineer and H&H Modeler with twelve years of experience in modeling for Everglades restoration projects. She has an M.Sc. (WRE) from BUET and an M.Sc. (CAE) from CMU. She taught Civil Engineering for five years.

Contact Information: Fahmida Khatun, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL, USA 33406, Phone: 561-682-2630, Email: fkhatun@sfwmd.gov

HYDROGEOPHYSICAL CHARACTERIZATION OF GROUNDWATER IN THE MANGROVE LAKES REGION OF EVERGLADES NATIONAL PARK.

Michael E Kiflai[1], *Dean Whitman*[1], *Rene M. Price*[1, 2], *Tom A. Frankovich*[2], *Joshua Allen*[1]
[1]Department of Earth and Environment, Florida International University, Miami, FL, USA
[2]Southeast Environmental Research Center, Florida International University, Miami, FL, USA

Everglades National Park has been adversely impacted by past human activities that altered freshwater flow through the system. Moreover, the highly permeable limestone aquifers bounded by ocean and brackish bays makes the coastal aquifers of south Florida highly susceptible to saltwater intrusion. The Comprehensive Everglades Restoration Plan (CERP) makes an effort to restore the quantity, quality, timing and distribution of water in the region. Major activities of the CERP, such as raising of Tamiami Trail and construction of the C-111 Spreader Canal Project are expected to increase the flow of fresh water and modify the groundwater chemistry of the area.

Electromagnetic methods provide a rapid and noninvasive set of techniques to evaluate the quality and distribution of groundwater chemistry in the lakes. EM survey were conducted in Alligator Creek (West Lake) and McCormick Creek (Seven Palm) from 2013 to 2016. During the survey a GSSI Profiler EMP-400, multi- frequency Electromagnetic (EM) conductivity meter was deployed in a flat bottomed plastic kayak towed behind a motorized skiff. The result along the 1 KHz have deep penetration and include the conductivity of the surface water and groundwater while that of 16 KHz have shallow penetration and represent the conductivity of the surface water. The apparent conductivity of the 16 KHz data varies from 1100 to 2000 mS/m during the wet season and reaches up to 3500 mS/m during the dry season. This demonstrates how the conductivity (e.g. salinity) of the surface water increases during the dry season due to reduced precipitation and freshwater flow. Furthermore, the conductivity of the water increases from North to South in Seven Palm and from west to east in West Lake.

The 1 KHz data shows a considerable decrease in apparent conductivity between May 2014 and April 2016 in the Seven Palm Lake system. In May 2014, apparent conductivity ranged from 1300 mS/m at the northern end of Seven Palm Lake to 3200 mS/m in Monroe Lake, whereas in April 2016 it ranged from 1000 to 2300 mS/m. This change suggests a freshening of the groundwater and may reflect the effects increased flow due to restoration efforts. Future work will include inverse modeling and salinity estimates for the groundwater and will integrate the EM data with DC resistivity measurements collected from a floating Schlumberger array.

BIO: Mr. Kiflai is a PhD student at the department of Earth and Environment, Florida International University. He has designing geophysical field apparatus and analyses the EM data for Everglades restoration project. He instructs the course introduction to environmental science lab for undergraduate students.

Contact Information: Michael E Kiflai, Department of Earth and Environment, PC-325, Florida International University, 11200 SW 8th Street, Miami, FL 33199, Phone: 305-348-7676, Email: mkiflai@fiu.edu

ROLE OF VEGETATION ON PHOSPHORUS REDUCTION IN THE EVERGLADES STORMWATER TREATMENT AREAS

Jill King
South Florida Water Management District, West Palm Beach, FL, USA

The Stormwater Treatment Areas (STAs) have proven to be very effective in reducing Total Phosphorus (TP) in the surface water runoff before the water is discharged to the Everglades Protection Area. Aquatic vegetation plays important roles in P reduction in the STAs, including: i) providing resistance to flow and thereby promoting particulate settling, ii) nutrient uptake and turnover, iii) storage, and iv) microbial activity related to epiphytic periphyton and decomposing litter. The vegetation types in the STAs are emergent aquatic vegetation (EAV, such as *Typha sp.*), submerged aquatic vegetation (SAV, such as *Najas sp.* and *Chara sp.*), and floating aquatic vegetation (FAV, such as *Nymphaea odorata*). The landscape and spatial distribution of vegetation vary among the different STAs and among different cells.

Historical vegetation information for the STAs has been focused primarily on spatial assessment of EAV vs. SAV area coverage and relative abundance of SAV species. There has been very limited information on nutrient storage within vegetation communities in the STAs. As part of the Everglades Restoration Strategies Science Plan implementation, an extensive study on the different mechanisms and storage of P and other nutrients is underway. This study includes a more frequent estimation of SAV species abundance, quantification of nutrient storage in both EAV and SAV, and release of P from litter and floc. A summary of historical vegetation information will be presented. The presentation will focus on comparison of biomass composition and P storage in an EAV cell (STA-2 Cell 1) versus an SAV cell (STA-2 Cell 3) will be presented. Initial results in these two cells show a distinct decreasing gradient in tissue P storage, indicating higher P uptake in the region closest to the inflow structures, where P loading is highest, and lower uptake at the backend of the flow-way where P loading is lowest. In SAV cells, there was an increasing gradient in tissue total carbon and total calcium and a less distinct gradient for total nitrogen. Temporal changes in biomass composition and P storage in these cells will also be presented. New information gathered from these more intensive vegetation surveys and sampling will provide inputs to the overall integrated assessment of the P cycling mechanisms and help with assessing short-term and long-term storage of P within the STAs.

BIO: Jill King is a science supervisor with the South Florida Water Management District. She was previously with the Department of Environmental Protection for 10 years as the manager of the Environmental Resources Program and has extensive experience working in the Everglades and coastal ecosystems.

Contact Information: Jill King, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL, USA 33406, Phone: 561-682-6544, Email: jking@sfwmd.gov

CHANGES IN SALINITY IN THE ST. LUCIE ESTUARY AND IMPLICATIONS FOR SNOOK MOVEMENT PATTERNS

***Lauren Kircher*[1]**, *Joy Young*[2], *Jessica Noble*[1], *Matia Gingras*[1], *Lissette Geubelle*[1], *and John Baldwin*[1]

[1]Florida Atlantic University, Boca Raton, FL

[2]Florida Wildlife Research Institute, Tequesta, FL

Many animals use environmental cues to initiate movement to find a habitat where the conditions best optimize their fitness. Common snook (*Centropomus undecimalis*), a tropical euryhaline sportfish, are already living at the northern boundary of their temperature range in southern Florida. They likely utilize movement to avoid cold fronts which could result in death. While this is a natural cue, there can be anthropogenic influences on environmental cues.

Freshwater flow is a likely spawning cue for common snook to move between freshwater rivers and nearshore marine environments during the summer months. Higher salinity waters ensure egg buoyancy and sperm motility. During drought years, snook will spawn within a river instead of moving to ocean inlets. In wet years, Lake Okeechobee releases large pulse discharges of freshwater to avoid flooding during storm events. While common snook are relatively tolerant to salinity (0-40ppt), there are osmoregulatory costs associated with changing salinities and movement.

In order to understand the effects of changing water quality on snook movement, we will compare changes in water quality patterns (salinity, flow volume, and temperature) in St. Lucie River before, during, and after high pulse events using South Florida Water Management's DBHYDRO and EPA's STORET environmental open-source databases, over multiple years. Future research will relate these water quality data patterns to other databases of common snook movement to further inform management.

<u>BIO</u>: Lauren Kircher is a Ph.D. student at Florida Atlantic University working under Dr John Baldwin. She is researching environmental influences on snook movement and mentoring two undergraduate students working on the biology of snook.

<u>Contact Information</u>: Lauren Kircher, Florida Atlantic University, 3200 College Ave, Davie, FL 33314, Phone:585-208-8148, Email:lkircher2015@fau.edu

EXPANSION AND DOMINANCE OF NON-NATIVE FISH POPULATIONS ACROSS EVERGLADES NATIONAL PARK

***Jeffrey L. Kline*[1]** *and Joel C. Trexler*[2]
[1]South Florida Natural Resources Center, Everglades National Park, Homestead, FL USA
[2]Florida International University, North Miami, FL USA

South Florida's interconnected landscape of protected natural areas, highly disturbed habitats, and large urban centers set in a subtropical climate poses a challenging environment for invasive fish management. The result has been a large number of introduced species and a steady increase in non-native fishes that have become established in both state and federally managed freshwaters. An earlier study documented that the introduction of new non-native fishes appeared to correspond with changes in water management and connectivity of canals delivering water to Everglades National Park (EVER) marshes. Here we explore patterns and potential drivers of the non-native fish populations in EVER. In addition, recent and upcoming water management changes, some associated with restoration actions, are highlighted and the potential influence on the spread of non-native species is discussed.
Multiple datasets are integrated to document the changes in spatial spread, abundance, and relative abundance of some of the new non-native species that entered EVER since 2000. These datasets provide both quantitative and qualitative estimates of abundance and occupancy on the marsh. Several species have established populations and some continue to expand in abundance in EVER. One species in particular, the African Jewelfish (*Hemichromis letourneuxi*) spread rapidly across the shorter hydroperiod marshes and has begun to be collected in higher relative abundance in quantitative samples in Shark River Slough. During the past several years, the African Jewelfish has become the most abundant non-native fish in EVER marshes.

Introduction and establishment of new populations of non-native species may be a side effect of restoration actions. Recent and proposed changes in water management along both the northern and eastern boundary of EVER alter flow directions and actively use canals to distribute water to EVER. Future introductions may be expected if new non-native fishes spread through the canal system toward the Everglades and as restoration actions alter water delivery patterns through canals that provide refuge for non-native fishes. As new non-native species spread into Everglades wetlands and populations of some species expand, a next step will be to evaluate potential impacts on native species and the ecology of Everglades marshes.

BIO: Jeff Kline is a fish biologist with more than 17 years of experience monitoring and evaluating the freshwater fish assemblage of Everglades National Park.

Contact Information: Jeffrey Kline, South Florida Natural Resources Center, Everglades National Park, 40001 State Road 9336, Homestead FL USA 33034, Phone 305-242-7825, Email: jeff_kline@nps.gov

EFFECTS OF A US-1 MITIGATION EFFORT ON HYDROLOGIC CONDITIONS AND SAV ABUNDANCE

Jerome Lorenz, Peter Frezza and ***Michael Kline***
Audubon of Florida, Everglades Science Center, Tavernier, FL, USA

Audubon's Everglades Science Center has been monitoring hydrologic conditions in the coastal mangrove zone of northeastern Florida Bay since 1990. The emphasis of this research is how these hydrologic conditions affect submerged aquatic vegetation (SAV) and fish populations in the watershed. Since 1996, surveying of SAV has been conducted bi-monthly at select sites. At each site, 6 fixed stations are surveyed along a salinity gradient; beginning at a hydrologic monitoring station upstream and ending at Florida Bay. Abundance estimates of SAV are assessed using a point intercept percent coverage method. Salinity, temperature, water depth and water clarity of surface water are measured at each station on the day of the survey. The Higway Creek (HC) site is located in the C-111 watershed and is directly adjacent and to the west of the '18 mile stretch' section of US1. In January of 2008, construction was completed on an expansion of the '18 mile stretch' section of US1 from Florida City to Key Largo which included the creation of 14 box culverts under the roadbed and the construction of a bridge which replaced a box culvert at the location of Manatee Creek at the Monroe/Miami-Dade County line. The result of the construction was increased hydrologic connection of the wetlands on the west side of the highway, where the HC site is located, to southern Biscayne Bay. Water level, Salinity, and Total SAV abundance were compared before and after culvert completion using Analyses of Variance (ANOVA) ($p<0.05$) and Tukey's Honest Significant Difference (HSD) for post hoc tests ($p<0.01$). The six stations along the HC transect were grouped into two subcategories: upstream (HC1A – HC4A) and downstream (HC5 – HC6) of Highway Creek proper. Upstream sites exhibited annual mean salinities ranging from 11.17-13.85 psu and were characterized by Total SAV abundances composed primarily of *Chara hornemannii*, > 58% of the Total SAV abundance. Downstream sites exhibited annual mean salinities ranging from 17.51-22.28 psu and were characterized by Total SAV abundances composed primarily of *Halodule wrightii*, > 79% of the Total SAV abundance. Average water levels increased both upstream by 3.42 cm and downstream by 5.03 cm after culvert completion ($p<0.01$). Annual mean salinities at all stations increased with increasing water levels after culvert completion; yet, only downstream was this salinity increase significant ($p<.01$). Upstream annual mean salinities increased by 2.7 psu and downstream by 5.56 psu. SAV abundance changed in concurrence with these shifts in the physical parameters. Although there were no major shifts in SAV community structure, the abundances of the most prolific species changed. Upstream, total SAV abundance increased by 17.62% after culvert completion ($p<.01$). Almost all of this increase was represented by *Chara hornemannii*. Most distinctively, at HC1A, the most upstream station of the transect, *Chara hornemannii* abundance increased by two orders of magnitude ($p<.01$). The same trend was observed downstream, total SAV abundance increased by 53.47% after culvert completion ($p<.01$). Again, the most prolific species increased in abundance, *Halodule wrightii*. *Halodule wrightii* abundance increased by 84.61% after culvert completion ($p<.01$).

BIO: Michael Kline is a research technician with 10 years of experience studying submerged aquatic and emergent wetland plant communities.

Contact Information: Michael Kline, Audubon of Florida, Everglades Science Center, Tavernier, FL, USA, Phone: 305-852-5318, Email: mkline@audubon.org

PREY SELECTION BY THE LITTLE BLUE HERON (*EGRETTA CAERULEA*) IN GREAT WHITE HERON NATIONAL WILDLIFE REFUGE

***Emilie R. Kohler*[1]**, *Marisa T. Martinez*[1], *Dale E. Gawlik*[1], *and Stephanie S. Romanach*[2]
[1]Florida Atlantic University, Boca Raton, FL, USA
[2]USGS, Davie, FL, USA

Little blue herons (*Egretta caerulea)* are generalists that eat insects, crustaceans, and fish, but little is known about their diet preferences. Diets may shift spatially from freshwater to marine systems or temporally between breeding and non-breeding periods. Identifying prey species preferences is an important step in understanding how little blue heron foraging habitat may be affected by environmental variation such as water management regimes and sea level rise. We investigated prey selection by little blue herons in Great White Heron National Wildlife Refuge (GWH) during the 2016 breeding period. We sampled prey communities at 74 locations along mudflats at low tide using a 1-m^2 throw trap to determine prey availability. We collected 53 samples of stomach regurgitate from 26 nests with chicks aged 1 to 4 weeks from a nesting colony within GWH to assess prey selection. While shrimp (*Penaeus* spp. and *Alpheus* spp.*)* were the most abundant taxa in throw traps and contributed to 44% of the available prey community, shrimp contributed to 39% of the diet. Fish were the most abundant taxa in regurgitate samples and contributed to 56% of the diet. Gulf toadfish (*Opsanus beta*) was the most abundant fish species contributing to 31% of the diet but only contributed to 4% of the available prey community. Though these results indicate that little blue herons at GWH are highly selective for gulf toadfish In addition to estuarine species, little blue herons also consumed terrestrial prey suggesting foraging habitat is not exclusive to tidal flats.

BIO: Emilie Kohler is a second year Master's student in the Environmental Science program at Florida Atlantic University. She completed her BS in Biology at Shippensburg University, PA.

Contact Information: Emilie Kohler, Department of Biological Sciences, Florida Atlantic University, 777 Glades Road, SC 248, Boca Raton FL 33431, Phone: 717.823.0259, Email: ekohler2015@fau.edu

SHIFTING LONG-TERM BIOGEOCHEMICAL BASELINES: ENHANCED MARINE CONNECTIVITY INCREASES NUTRIENT AVAILABILITY IN COASTAL WETLAND ECOSYSTEMS

J.S. Kominoski[1,5], *E. Casteñada-Moya*[1,5], *S.E. Davis*[2,5], *E.E. Gaiser*[1,5], *L. Marazzi*[1,5], *V.H. Rivera-Monroy*[3,5], *Andres Sola*[1,5], *Donatto Surratt*[4,5]

[1]Department of Biological Sciences & Southeast Environmental Research Center, Florida International University, Miami, FL , USA
[2]Everglades Foundation, Palmetto Bay, FL, USA
[3]Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, USA
[4]Everglades National Park, Homestead, FL, USA
[5]Florida Coastal Everglades Long Term Ecological Research Program, FL, USA

Enhanced marine connectivity in coastal ecosystems is driven by storm pulses, sea-level rise (SLR), and saltwater intrusion. Biogeochemical changes of increasing saltwater intrusion into brackish and freshwater wetland ecosystems are uncertain. We analyzed 15 years (2000 – 2014) of continuous data from the Florida Coastal Everglades Long Term Ecological Research Program (FCE LTER) to assess spatiotemporal shifts in carbon (C) and phosphorus (P) along two freshwater-marine gradients (Shark River Slough, SRS; Taylor Slough/Panhandle, TS/Ph). We specifically tested 1) how ecosystem P allocation (water, plant, soil) varied among wetland ecosystems with differential marine connectivity and P demand, and 2) how differences in ecosystem P allocation are explained by differences in water source (freshwater, marine), P loading, and ecosystem productivity. Surface and porewater total P in freshwater, brackish and marine wetlands along the SRS increased up to 3× from 2005 through 2014 in both wet and dry seasons, following Hurricane Wilma impact; whereas surface and porewater total P increased up to 3× throughout TS/Ph primarily occurred during the dry season. Soil total P was highest in SRS marine and brackish wetlands and steadily increased in both gradients from freshwater to marine wetlands. Above and belowground total P in a dominant freshwater plant species *Cladium jamaicenses* was 2× higher in SRS than TS/Ph and increased from 2010 through 2014 in wetlands nearest to the freshwater-marine ecotone. Long-term effects of nutrient uptake on C storage in oligotrophic ecosystems likely balance ecosystem nutrient allocation and net ecosystem productivity at the landscape level.

BIO: Dr. Kominoski is an ecosystem ecologist and co-PI of the Florida Coastal Everglades Long Term Ecological Research Program. His research focuses on subsidy-stress effects on organic matter processing and biogeochemical cycling in ecosystems. His lab studies terrestrial, aquatic, and wetland ecosystems throughout the Southeastern U.S., including the Florida Everglades.

Contact Information: John Stephen Kominoski, Department of Biological Sciences & Southeast Environmental Research Center, Florida International University, 11200 SW 8th Street, Miami, FL, USA 33199, Phone: 305-348-7117, Email: jkominos@fiu.edu

WATER STORAGE FEATURES IN THE COMPREHENSIVE EVERGLADES RESTORATION PLAN (CERP) – ORIGINAL GOALS AND CURRENT STATUS

Robert Johnson, and ***Kevin Kotun***
National Park Service, Everglades National Park, FL, USA

The adverse impacts of wetland losses in the Everglades have been documented since the 1940's. A major goal of Everglades restoration is to redirect harmful discharges away from the northern estuaries, by re-establishing water flows from Lake Okeechobee into the central and southern Everglades but these improvements are dependent on new water storage. The Everglades restoration goal to "Get the Water Right", calls for 1.8 million acre-feet of new surface water storage by 2036, and capacity to store 1.7 billion gallons per day in below ground storage by 2030 (Strategy and Biennial Report, 2016).

While a number of key pre-CERP and CERP restoration projects have been advancing, and we are starting to see on-the-ground ecosystem benefits, progress on achieving these water storage goals has been slow. In addition, dam safety concerns with the 1920's era Herbert Hoover Dike around Lake Okeechobee have led to a substantial reduction in wet season lake stages, which has reduced available water storage compared to what was originally envisioned in CERP. Increased water storage in the Everglades is critical to buffering both the natural and built ecosystems from the detrimental effects of frequent floods and droughts, and is even more important as we look for opportunities to increase the system's resilience to climate change.

More than 1.2 million acre-feet of new surface water storage was envisioned in the CERP. Surface water storage is important for rapid removal of stormwater runoff, but provides less carry-over drought protection than below ground storage. Two large above ground reservoirs in the Caloosahatchee and St. Lucie basins are moving forward, and are expected to produce approximately 120,000 acre-feet of new storage for local basin runoff. While a large (200,000 ac-ft) above ground reservoir is being considered in the current Lake Okeechobee Watershed Plan, storage in the Upper East Coast has been scaled back (from 350,000 ac-ft to 110,000 ac-ft), and the reservoir planned for the Everglades Agricultural Area (360,000 ac-ft) has no planned construction before 2035. New surface water reservoirs that are planned to date therefore account for approximately 30-40 percent of the original CERP storage goal. Three in-ground storage reservoirs, with a total capacity of 325,000 acre-feet, were also planned in CERP to capture wet season runoff, with greater potential for longer-term drought protection. Unfortunately one reservoir has been re-purposed to improve water quality treatment, while the other two Lakebelt reservoirs do not appear to be feasible. Aquifer storage and recovery (ASR), the largest single water storage component in CERP, has also been scaled back to approximately 40 percent of the assumed inflow/outflow capacity due to hydro-geologic limitations.

The potential loss of over 1 million acre-feet of new CERP storage, combined with a >500 ac-ft reduction of Lake Okeechobee storage, raises significant concerns for our ability to achieve the planned benefits for both the natural and built ecosystems. These storage changes will need to be closely evaluated as Everglades restoration progresses, particularly in light of climate change projections for South Florida.

Biography: Robert Johnson is a supervisory hydrologist, and the Director of the South Florida Natural Resources Center, with more than 30 years of experience planning, designing, and implementing Everglades natural resources preservation and restoration projects.

Contact Information: Robert Johnson, South Florida Ecosystem Office, 950 North Krome Avenue, Homestead, FL, USA, 33030, Phone:305-224-4200, Email: robert_johnson@nps.gov.

DRIVERS OF GEOSPATIAL AND TEMPORAL VARIABILITY IN THE DISTRIBUTION OF MERCURY AND METHYLMERCURY IN EVERGLADES NATIONAL PARK

David Krabbenhoft[1], *Michael Tate*[1], *John DeWild*[1], *Jacob Ogorek*[1], *George Aiken*[2], *William Orem*[3], *Jeffrey Kline*[4], *and Joffre Castro*[4]

[1]U.S. Geological Survey, Middleton, WI, USA
[2]U.S. Geological Survey, Boulder, CO, USA
[3]U.S. Geological Survey, Reston, VA, USA
[4]National Park Service, Everglades National Park, Homestead, FL, USA

Elevated mercury (Hg) in the food web has been a public concern in the Florida Everglades since the late 1980s, and has been a persistent issue confronting the ecosystem restoration efforts. Ecosystem-scale factors influence Hg bioaccumulation in the Everglades, including enhanced atmospheric Hg deposition, land and water use and management, and environmental disturbances (e.g. fire and droughts). In the Everglades, the production of methylmercury (MeHg), the most toxic and bioaccumulative form of environmental Hg, is driven by the bioavailability of inorganic Hg(II) and the metabolic activity of sulfate reducing bacteria (SRB), which in turn are influenced abundance and character of dissolved organic carbon (DOC) and sulfate loading.

To assess the distribution of Hg and MeHg within Everglades National Park (ENP), the U.S. Geological Survey and the National Park Service conducted annual surveys of surface water and forage fish (Gambusia and Jewell Fish) at 76 sites from 2008 to 2015. Water and fish were analyzed for total mercury (HgT) and MeHg. Water samples were also analyzed for DOC, SUVA (specific UV absorbance at 254 nm), and major ions. Annual climatic variability (the number of days a site was dry in the period preceding sampling) was also analyzed as a driver of MeHg production.

MeHg concentrations in water and fish exhibited distinct regional patterns, peaking within the Shark River Slough (SRS), the receiving area for sulfate and DOC rich canal water. Throughout SRS, HgT was a strong predictor of MeHg concentrations (R^2=0.70 for filtered water). Nutrient availability limitations in non-canal-affected marsh sites weakened this relationship (R^2=0.15). Fish Hg trends generally followed those of surface water, with the exception of an HgT spike in marsh fish during a very wet El Niño year (2010), allowing enhanced fish dispersal from SRS. Otherwise, the El Niño event caused a decrease in HgT and MeHg concentrations, while a strong La Niña event caused a dramatic increase in concentrations. A gradient boosting regression analysis revealed that the importance of other drivers of MeHg production, relative to HgT concentrations, (particularly the number of dry days preceding sampling, sulfate, and SUVA) was greatly enhanced in the marsh, relative to SRS. During the eight years of this study, the prevalence of exotic Jewell Fish has rapidly expanded, and in some cases nearly replaced Gambusia. This is important because overall we observe that Jewell Fish Hg concentrations are about are about 15-20% greater that Gambusia when collected at the same location. It is undetermined if this change in forage-fish Hg concentration is affecting high-level trophic fish in ENP.

BIO: David Krabbenhoft is a senior research scientist with USGS, and has been researching mercury contamination of the environment for nearly 30 years.

Contact Information: David Krabbenhoft, U.S. Geological Survey, 8505 Research Way, Middleton, WI, 53562 USA, Phone: 608-821-38043, Email: dpkrabbe@usgs.gov

STICK IN THE MUD: MANGROVE LOSS IN SOUTH FLORIDA

***David Lagomasino*[1,2]**, *Lola Fatoyinbo*[2], *Bruce Cook*[2], *Emanuelle Feliciano*[1,2], *SeungKuk Lee*[1,2]
[1]Universities Space Research Association, Columbia, MD USA
[2]NASA Goddard Space Flight Center, Greenbelt, MD USA

Blue carbon ecosystems store and sequester most of their carbon stocks in peat as long as they can maintain a balance between sediment accretion and sea-level rise. Sea-level rise and seawater intrusion pose high-risks of change to mangrove forests and coastal marshes, which can result in extraordinary changes to inundation and salinity that impact both above and below ground carbon cycling. As a result, rapid changes in inundation or salinity brought upon by climate change, accelerated sea-level rise, storm surges, or increased water flow through restoration efforts will collectively have an impact on regional and global carbon cycling. Remote sensing plays a crucial role in our ability to monitor changes to the landscape at regional scales.

NASA Goddard's LiDAR, Hyperspectral and Thermal airborne imager (G-LiHT) collected data over Everglades National Park in May 2015. These acquisitions targeted critical vegetation, hydrologic, and salinity gradients that were also areas with existing ground plots in the marsh and mangrove forests. Repeat flights are scheduled for spring of 2017. By collecting lidar, optical, and thermal data simultaneously over space and time, we can derive new algorithms to better map plant species compositions, vegetation and ecosystem health, and biomass and carbon stocks. G-LiHT data from the study domain will provide a link for upscaling ground data to long-term satellite observations in order to measure temporal landscape dynamics. Combining measurements of vegetation structure, foliar spectra, and surface temperatures using the G-LiHT imager has delivered well-calibrated results and has proven successful in determining forest inventories and individual tree structures

Combining 3D mapping methodologies with biophysical spectral responses we can quantitatively access forest and vegetation structure and health. Using both the structure and function of the environment we can identify areas of ecosystem change and whether that change could lead to the vulnerability of peat collapse or chronic change. The main goal of this project is to develop a new monitoring framework from the fusion of readily-available ground, airborne, and spaceborne remote sensing datasets to quantify and predict rapid changes or collapse of the blue carbon landscapes. Preliminary results have identified large areas of mangrove die-off and that will, subsequently, be observed during the 2017 G-LiHT flight campaign. These types of data are now available or planned over the Florida Everglades as part of NASA and other institutionally-funded research. Combining these datasets will enable us to estimate forest and ecosystem changes, identify areas vulnerable to collapse, and model changes to regional carbon and water cycling to inform current restoration and research efforts in the Everglades.

BIO: Dr. Lagomasino is an Earth Systems Ecologist with over 10 years of experience working in coastal wetlands, including the Everglades. He has extensive experience with monitoring wetland ecosystem structure from space using a variety of different sensors. He has been involved with coastal wetland research in the Americas, Africa and Asia.

Contact Information: David Lagomasino, Universities Space Research Association, Greenbelt, MD, 8800 Greenbelt Road

CONFIRMING SAFETY: ECOLOGICAL HOST-RANGE AND MONITORING FOR SPILLOVER IN WEED BIOLOGICAL CONTROL

Ellen C. Lake[1], *Paul D. Pratt*[2], *Philip W. Tipping*[1], *Min B. Rayamajhi*[1], *F. Allen Dray, Jr.*[1], *Melissa C. Smith*[1] *Greg S. Wheeler*[1], *Susan Wright*[2], *Ian Jones*[1], *Ted D. Center*[1]
[1]USDA ARS Invasive Plant Research Laboratory, Fort Lauderdale, FL, USA
[2]USDA ARS Exotic and Invasive Weeds Research Unit, Albany, CA, USA
[3]USDA ARS Invasive Plant Research Laboratory, Gainesville, FL, USA

Quarantine host-range testing effectively predicts the physiological host-range of candidate weed biological control agents, the plants on which adults will readily feed and immatures will complete their development. However, quarantine tests must be conducted in cages, which may limit the full use of an arthropod's host-searching behaviors. The ecological host-range of an arthropod includes all the plants an agent will utilize when given the opportunity to use its full suite of host seeking and acceptance behaviors in an open field setting. It can be more restrictive than the physiological host-range. In the introduced range of an agent, ecological host-range tests are conducted after an agent is approved for field release. During a typical test, the agent is released in an array of test plants that include the target weed and closely related non-target plants. The behavior of the agent can be assessed by monitoring for feeding damage, oviposition and subsequent activity of immature life stages, and by measuring the duration of time spent on the target weed compared to non-target plants. This test can be followed by a second phase that provides a no-choice scenario by killing the target weed. Once the target weed is dead, the behavior of the agent is evaluated in the presence of the closely related non-target plants but the absence of its preferred host. An additional post-release concern is that an agent may cause damage if it builds up large numbers in the field, decimates the target weed, and then spills over onto non-target plants. Spillover damage is not common, and when it occurs, it tends to be very transient.

The results of ecological host-range and spillover tests can help to ameliorate public concern about biological control programs and can also provide information to help refine the quarantine testing process of future agents. The Invasive Plant Research Laboratory has evaluated the ecological host range of several biological control agents, including agents for *Melaleuca quinquenervia* (Cav.) S.F. Blake, melaleuca, and *Dioscorea bulbifera* L., air potato. The tests of the three melaleuca agents and *Lilioceris cheni*, the air potato leaf beetle, supported the results of the quarantine testing, that the agents did not pose a risk to non-target plants. A spillover test was conducted by placing potted plants of air potato and the native non-target *Dioscorea floridana* L. in three field patches of air potato with active populations of *L. cheni*. The *D. floridana* plants received minor test feeding but after one week in the field *L. cheni* eggs and/or larvae were only present on air potato plants, confirming that this agent does not pose a spillover risk to the native congener.

BIO: Dr. Lake is an entomologist whose research in weed biological control includes investigation of agent host-range, plant-arthropod interactions, integrated weed management, and restoration ecology.

Contact Information: Ellen Lake, USDA Agricultural Research Service Invasive Plant Research Laboratory, 3225 College Avenue, Fort Lauderdale, FL, USA 33314, Phone: 954-475-6548; Email: ellen.lake@ars.usda.gov

MAPPING VEGETATION PROPERTIES AND FLOW PATTERNS IN STORMWATER TREATMENT AREAS (STAS) USING WAVE TESTS

***Wasantha Lal**, Zaki Moustafa, and Walter Wilcox*
South Florida Water Management District, West Palm Beach, FL, USA

Artificially generated water waves were used in an experiment to determine combined effects of vegetative resistance and topographic features on flow distribution within STAs. The wave speeds and wave decay characteristics measured at points located in a triangulated network were used to calculate the resistance to flow, which depends on the energy gradient and the depth. The results are used to produce two-dimensional maps of hydraulic transmissivities, stem drag resistance coefficients, and parameters of power-law equations describing resistance. The results also include bulk parameters or single parameters defined for the entire wetland.

Results show that the patterns of many resistance parameters plotted in two dimensions (2-D) are similar to the general patterns of the distribution of vegetation in areal maps. The results indicate that use of power-law equations is one of the most effective ways to parameterize vegetation resistance. The results were used to interpret blockages, effects of short-circuiting and turbulent behaviors. The results include dimensionless parameters that can be used to determine if the governing equation is primarily hyperbolic or parabolic, and to what extent the flow behaves like porous media flow with diffusive wave behavior or short-circuiting stream flow with kinematic wave behavior.

<u>BIO</u>: Dr. A. M. Wasantha Lal is a principal engineer working at SFWMD for 23 years, primarily developing a regional simulation model RSM for the district. He has extensive experience with computational hydraulics, hydrology, water resources systems, in US and abroad. His current efforts are geared towards continued development of computer models that can simulate hydrologic and hydrologic conditions in urban, agricultural and natural conditions.

<u>Contact Information</u>: Wasantha Lal, South Florida Water Management, 3301 Gun Club Rd, West Palm Beach, FL, USA 33406,
Phone: 561-682-6826, Email: wlal@sfwmd.gov

NEW CLIMATE CHANGE INFORMATION FOR CONSIDERATION IN ENHANCING EVERGLADES RESTORATION CLIMATE PREPAREDNESS AND RESILIENCE

Glenn B. Landers
U.S. Army Corps of Engineers, Jacksonville, FL, USA

This presentation will provide a high level overview of new sea level rise and other climate change-related information that must be considered in Everglades Restoration implementation plans in order to achieve and sustain Everglades Restoration benefits. Relevant new USACE guidance will be discussed along with opportunities for RECOVER system-wide monitoring and modeling to help expedite project level planning and inform decision making for adaptive management actions.

BIO: Glenn Landers is a professional engineer with 25+ years of experience planning, designing, and implementing Everglades Restoration projects. In the past he has served as senior project manager for the C-111, Modified Water Deliveries to ENP and CERP Aquifer Storage and Recovery (ASR) Pilot Projects and Regional Study. Currently he is a senior planner for Everglades Restoration and other water resources projects, and is a regional technical expert on climate preparedness and resilience.

Contact Information: Glenn B. Landers, P.E., U.S. Army Corps of Engineers, Jacksonville District, Planning and Policy Div., 701 San Marco Blvd., Jacksonville, FL 32207 Phone: 904-232-2125, Email: glenn.b.landers@usace.army.mil

INVASIVE SPECIES IN THE RESTORATION CONTEXT

Jon Lane
US Army Corps of Engineers, Jacksonville, FL, USA

Invasive species are negatively impacting human activities across the world (from citrus greening in agriculture, to zebra mussels and aquatic vegetation in navigation, water supply and flood control). Governments and industry spend billions of dollars annually trying to managing and mitigate the damages caused by these invasive species. Now we are undertaking the daunting task of restoring impaired ecosystems which are increasing being invaded and overtaken by non-native species. This presentation and session explore the complicated factors and impacts of invasive species within the context of restoring the Everglades.

BIO: Jon has been working with invasive species for over 25 years as a Peace Corps Volunteer, Fishery Biologist with the US Fish and Wildlife Service and for the past 18 years with the US Army Corps of Engineers in Florida. He has a Masters of Ag from Colorado State University.

Contact Information: Jon Lane, US Army Corps of Engineers, 701 San Marco Blvd., Jacksonville FL, 32065 Phone: 904-232-1044, Email: jon.s.lane@usace.army.mil

SENSITIVITY ANALYSIS OF TOTAL PHOSPHORUS IN A WETLAND BIOGEOCHEMICAL MODEL

Stefan Gerber and ***Kalindhi Larios***
Department of Soil and Water Science, University of Florida, Gainesville, FL, USA

Biogeochemical models are essential tools for understanding the cycling of nutrients in constructed wetlands, including linking disparate data collected at specific locations and time. This helps to identify data needs in order to evaluate and predict the wetland's performance with respect to nutrient removal. A variance based global sensitivity analysis (GSA) was performed on an expanded mechanistic biogeochemical model by Paudel and Jawitz (2012), including a first-order sensitivity index (S_i) and total effect index (S_{Ti}). S_i can be interpreted as the reduction in variance expected if a parameter is fixed and the rest of the parameters vary. On the other hand, S_{Ti} is the reduction in variance expected if a parameter varies while the rest of the parameters are fixed this includes parameter interaction effects. The Paudel and Jawitz model captures the movement of phosphorus (P) in major wetland reservoirs such as the water column, macrophytes, periphyton, floc, and soil along a 1-D flow path, based on the spiraling approach. The target variable for the GSA was the annual outflow total P concentration in a treatment wetland after 13 years. Specifically, we set out to understand how annual loads and the base release of P from soil influenced sensitivity. It was found that there is a strong sensitivity with water dynamic parameters water depth and hydrologic residence time (i.e. average flow velocity). We found this to be true regardless of a ten-fold change in annual loads and base release of P from soil, both of which would significantly affect overall load and P accumulation in newly formed wetland soils. We also note that the rate of base P release of is a sensitive parameter suggesting that legacy P is important in treatment wetlands. When comparing P removal rates, the strengths of parameters that determine the sequestration of P in litter and newly accreted soils are more sensitive compared to P uptake by macrophytes and periphyton. The parameter variations (factor of 3 for each of the parameter) created a significant variability in outlet P concentration (between 11.6 and 362 µg L^{-1}, 95 % confidence interval). The large spread in the modeled P concentrations (ca. factor of 6 compared to factor of 3 parameter uncertainty) supports the notion that multiple factors are affecting this variable.

BIO: Kalindhi Larios is a doctoral student studying biogeochemical modeling in the Department of Soil and Water Science at the University of Florida. She is currently working with Dr. Stefan Gerber to analyze and synthesize data in the Everglades Stormwater Treatment Areas.

Contact Information: Kalindhi Larios, MCCARTY A 3191, University of Florida, Gainesville, FL, USA 32611, Phone: 3005-906-0536, Email: rubym00n@ufl.edu

EFFECTS OF FLOW RECONNECTION ON CONNECTIVITY OF BIOGEOCHEMICAL PROCESSES IN THE CENTRAL EVERGLADES

Laurel G. Larsen[1,2], *Susan Newman*[3], *C. Saunders*[3] *and J. W. Harvey*[2]

[1]University of California, Berkeley, CA USA
[2]U.S. Geological Survey, Reston, VA USA
[3]South Florida Water Management District, West Palm Beach, FL USA

The Decompartmentalization Physical Model (DPM) is a pilot test of Everglades flow restoration, which tests uncertainties about whether pulsed flow releases can restore redistribution of sediment, a process thought to be essential for maintenance of the ridge and slough landscape, and restore functional connectivity across levee-canal barriers. Functional connectivity quantifies the extent to which the landscape regulates the spatial contiguity of biogeochemical and ecological processes such as phosphorus uptake, microbial metabolism, and conservative transport fluxes. Although much attention has been given to quantification of structural connectivity based on image analysis, the quantification of functional connectivity is not as far advanced. Here we use a novel complex-networks technique for quantifying functional connectivity to address uncertainties about how nutrients and conservative solutes move through the Everglades ridge and slough landscape in response to the physical reconnection realized through the DPM flow release experiments. Complex networks, used in hydroclimatology to resolve teleconnections, offer a promising approach for quantifying functional connectivity in watersheds. The approach resolves connections between nodes in space based on statistical similarities in the perturbation signals (derived from time series) of water quality constituents of interest and is sensitive to a wider range of timescales than traditional mass balance modeling. Here, monthly water quality grab samples collected from 12 repeat sampling locations within and outside the DPM footprint served as inputs to the complex-networks analysis. The output was a set of spatial networks for pre-flow and post-flow time periods, with connections between nodes (i.e., sampling locations) representing portions of the landscape that experience perturbations in water quality signals similarly.

We found that reintroduction of flow pulses after decades of isolation fundamentally reconfigured functional connectivity networks. While markers of canal water indicated transport across the entire DPM footprint, markers of biogeochemical processes and microbial metabolism were more spatially explicit. One of the most pronounced phenomena was expansion of the calcium network, which reflects periphyton dynamics and may represent an indirect influence of low-level phosphorus enrichment, despite the comparatively smaller observed expansion of total phosphorus networks. With respect to several solutes, periphyton acted as a "biotic filter," shifting perturbations in water-quality signals to different timescales through slow but persistent transformations of the biotic community. The complex-networks approach also revealed portions of the landscape that operate in fundamentally different regimes with respect to dissolved oxygen, separated by a threshold in flow velocity of 1.2 cm/s. The connectivity of several types of solutes across the different gap treatments at the downstream end of the footprint (including complete backfill, partial backfill, and no backfill of the canal) suggested that complete removal of canals may be needed to restore connectivity of conservative and nonconservative processes.

BIO: Dr. Larsen runs the Environmental Systems Dynamics Laboratory at the University of California, Berkeley. The lab takes a complex-systems approach to environmental problems, seeking to understand the set of interactions and feedbacks that produce emergent phenomena, with emphasis on understanding how flowing water structures the form and function of landscapes.

Contact Information: Laurel Larsen, Dept. of Geography, 507 McCone Hall, Berkeley, CA 94720, Phone: 510-529-5574,
Email: laurel@berkeley.edu

TRANSPORT OF PHOSPHORUS WITH SUSPENDED PARTICULATES DURING EXPERIMENTAL RESTORATION OF EVERGLADES HIGH FLOWS

Jennifer Lewis[1], *Jud Harvey*[1], *Laurel Larsen*[2], *Jay Choi*[1], *Allison Swartz*[1], *Brendan Buskirk*[1], *Sue Newman*[3], *and Colin Saunders*[3]

[1]U.S. Geological Survey - National Research Program, Reston, VA, USA
[2]University of California, Berkeley, CA, USA
[3]South Florida Water Management District, West Palm Beach, FL, USA

The mobility of particulate matter and associated phosphorus during high flow restoration reflect both the opportunities and the challenges for restoration success. On the one hand the mobilization of particulates from sloughs and redistribution onto ridges may help restore deepwater sloughs, however, the entrainment and movement of particle-associated phosphorus has the potential to over-enrich downstream areas. The Decompartmentalization Physical Model (DPM) experiments provided the opportunity to examine these tradeoffs in prototype at a large scale in order to answer questions about sources and fate of suspended particulates and how the ecological outcomes of restoration are influenced by particle dynamics. During several experimental DPM flow releases we used acoustic Doppler instruments to measure changes in water flow velocity and bed shear stress and we used laser diffraction particle size analyzers to measure changes in the average size of suspended particles in the water column and particles in the bed floc and in epiphytic coatings on submersed aquatic plants. All measurements were made in both sloughs and ridges at several distances from the flow release structure. Water column and bed floc and epiphyton particulate samples were analyzed to determine total particulate and total phosphorus concentration, loss on ignition (LOI), and character (i.e., mineral, plant or living microflora/faunal origin), source (bed floc vs. epiphyton) and lability (i.e. labile, microbial, or refractory) of the associated phosphorus. Comparison of pre-flow release and high-flow data for several experiments indicated that suspended particle concentrations that initially were 0.4 mg/L increased in short-lived pulses lasting hours by variable amounts ranging between a factor of two to twenty times before relaxing to near background concentrations. The size of suspended particles generally decreased from approximately 150 to 50 µm although responses were variable. Total phosphorus in the water column typically increased from 4 µg/L during the pre-flow period to 9 µg/L at high flow, reflecting a tendency for greater concentration of P in finer and more easily entrainable particles. Suspended material was entrained both from bed floc and epiphyton. Particle-bound phosphorus, at least initially, was primarily entrained from epiphyton. The fate of most suspended particles and its associated P was settling or capture on vegetation within 1,500 m of the flow release. Although most particulates settled in sloughs the highest areal rate of particle settling/capture was along ridge edges. We conclude that the footprint of enhanced phosphorus transport tends to be limited spatially due to attenuation of water flow velocity and flow depths with distance from the high-flow source, and also as a result of filtration of suspended particles by vegetation stems on ridges.

BIO: Jennifer received a B.S. from the Virginia Tech and has been a research associate with the USGS for two years. She worked for the field and laboratory work in the Greater Everglades Ecosystem

Contact Information: Jud Harvey, NRP, USGS, 12201 Sunrise Valley Dr., Reston, VA 20192 USA, Phone: 703-648-5877, Email: bbuskirk@usgs.gov

IMPACT OF CLIMIATE CHANGE AND SEA LEVEL RISE ON FARMLAND ADJACENT EVERGALDES

Yuncong Li[1], *Pamela Fletcher*[2], *Guodong Liu*[3], *and Younggu Her* [1]
[1]University of Florida, Homestead, FL, USA
[2]University of Florida, Fort Lauderdale, FL, USA
[3]University of Florida, Gainesville, FL, USA

South Florida agriculture is economically and ecologically important. The economic impact of agriculture in Miami-Dade County alone is about $2.7 billion. These farmlands occupies an environmentally sensitive areas adjacent to the Everglades and other nature ecosystems, are also not far from coastline, and directly impacted by climate change and sea level rise. Restoration and protection of Everglades ecosystem requires increasing ground water level during winter while farmlands need to be drained for planting crops at the same time. Sea level rise also leads to increasing level of groundwater in farmlands, causes frequent flooding plus potential salt water intrusion. For example, 60-70% vegetable crops in Miami-Dade County were damaged by flooding in December 2015.

Land use for agriculture was started over 200 years ago and probably will be continued for another 200 years. It is important to balance crop production and ecosystem conservation. Economically profitable and environmentally compatible agricultural practices must be developed and implemented to meet the needs of the agricultural industry and to protect these very fragile natural ecosystems. Several specific cases will be discussed during this presentation for illustrating possible solutions for growers in south Florida. The first cases will be how to manage high water table in croplands with low elevations. The second case will be how to alleviate salt damage for these area near coastline. The third case will be using nitrogen fixing cover crops to reduce the use of inorganic fertilizers and increase profitability. The presentation also includes how to conduct extension/outreach program. The outreach program should include not only documenting problems and consequences, but also provide management practices which has being proposed or used in other places to address sea level rise.

BIO: Dr. Li is a professor with three decades of experience of research and extension on soil and water quality and ecosystem restoration. He and his team have conducted many experiments inside Everglades and adjacent farmland during last 20 years, published more than 170 refereed papers and 90 extension articles.

Contact Information: Yuncong Li, Tropical Research and Education Center, University of Florida, 18905 S.W. 280 Street, Homestead, FL 33031, USA, Phone: 781-217-9251, Email: yunli@ufl.edu

DISTRIBUTION OF MERCURY SPECIES IN THE EVERGLADES: A GEOCHEMICAL PERSPECTIVE AND IMPLICATIONS ON MERCURY BIOACCUMULATION

***Guangliang Liu*[1]**, *Ping Jiang*[1], *Wenbin Cui*[1], *Peter Kalla*[2], *Dan Scheidt*[2] *and Yong Cai*[1]
[1]Florida International University, Miami, FL, USA
[2]U.S. Environmental Protection Agency, Region 4, Athens, GA, USA

The geochemical speciation of mercury (Hg) is of paramount importance with respect to the biogeochemical cycling of Hg in aquatic environments, as different Hg species may exhibit different reactivity and bioavailability during transport and transformation. For advancing the knowledge of aquatic Hg cycling, it would be helpful to understand how geochemical factors affect the distribution of inorganic Hg (iHg) species and subsequently control Hg transformation (e.g., methylation) and bioaccumulation.

The Everglades Regional Environmental Monitoring and Assessment Program (R-EMAP) of the United States Environmental Protection Agency has collected and analyzed samples, including surface water, soil, vegetation, and fish, throughout the Everglades at about 1000 different locations. This program has generated massive datasets, including total Hg, methylmercury (MeHg), and a variety of biogeochemical characteristics parameters, for the entire Everglades freshwater marsh. The simultaneous determination of Hg and geochemical characteristics at the same site provides an unprecedented data source and a unique opportunity for geochemical modeling of Hg speciation, as biogeochemical parameters, such as pH, dissolved oxygen, inorganic ions (e.g., chloride and sulfide), and dissolved organic matter (DOM), are readily available as model input parameters.

The geochemical model PHREEQC, with the careful consideration of sulfide and DOM in the input file MINTEQ.dat by including Hg-S and Hg-DOM complexes and corresponding stability constants, was employed to determine the speciation distribution of Hg in Everglades water at different sites. The results suggest that sulfide and DOM were the key factors that regulate inorganic Hg speciation in the Everglades. In the sampling stations with measurable concentrations of sulfide (> 0.02 mg/L), Hg-S species dominated iHg species, occurring in the forms of HgS_2^{2-}, $HgHS_2^-$, and $Hg(HS)_2$ that were affected by pH, among other factors. In the areas where concentrations of sulfide were reported below 0.02 mg/L, when sulfide was assumed nonexistent, Hg-DOM occurred as the predominant Hg species, accounting for almost 100% of iHg species. However, when a low sulfide concentration (0.00032 mg/L) was assigned to the sites below 0.02 mg/L to assume a virtual scenario of the presence of very low sulfide in natural waters, both Hg-DOM and Hg-S were present as the major iHg species. The implications of the distribution of iHg species on important Hg transformation processes and the overall Hg cycling in this ecosystem were discussed.

BIO: Dr. Liu is a research scientist in environmental chemistry investigating the fate, transport, and transformation of toxic metals, in particular mercury, in aquatic environments. He has more than 10 years of experience studying the biogeochemical cycling of mercury in the Everglades.

Contact Information: Guangliang Liu, Department of Chemistry & Biochemistry and Southeast Environmental Research Center, Florida International University, 11200 SW 8th St, Miami, FL, USA 33199, Phone: 305-348-6235, Email: liug@fiu.edu

GEER 2017 INTEGRATED PHOSPHORUS MODEL TO EVALUATE CHANGES IN LAND MANAGEMENT IN AGRICULTURAL BASINS NORTH OF THE EVERGLADES

Maria Loinaz[1], *Stephanie Long*[1], *Brent Whitefield*[2], *Georgia Vince*[3], *Jennifer Leeds*[4], *Jeremy McBryan*[4]
[1]ADA Engineering, Inc., Tampa, FL, USA
[2]ADA Engineering, Inc., West Palm Beach, FL, USA
[3]Tetra Tech, Inc., West Palm Beach, FL, USA
[4]South Florida Water Management District, West Palm Beach, FL, USA

Long-term planning measures for the Everglades Protection Area are being implemented by the South Florida Water Management District (SFWMD) in order to achieve the water quality goals and meet EPA water quality standards for the Everglades. One of the critical challenges is to achieve compliance with the total phosphorus (TP) standards due to impacts of the extensive agricultural areas in central Florida.

The Western Basins region is located at the junctions of Hendry, Collier, Palm Beach, and Broward counties and consists of the C-139, Feeder Canal, L-28, and L-28 Gap Basins. The Western Basins Water Resources Evaluation (WBWRE) project provides the foundation to study potential hydrologic and water quality improvements for the Western Basins. The Feeder Canal Basins are non-Everglades Construction Project basins (i.e., basins that discharge directly into the Everglades Protection Area without going through a stormwater treatment area (STA)). As such, the Florida Department of Environmental Protection requires SFWMD to monitor and report on the progress to meet water quality standards in these basins. WBWRE aims to develop a Comprehensive Basin Watershed Management Plan that meets the US EPA non-point source management plan.

As part of the WBWRE project a tool that simulates the movement of phosphorus throughout the surface water and groundwater system was developed. The tool can be used to evaluate the impacts on phosphorus concentrations in the Feeder Canal Basin outflow canals caused by changes in land use, land management practices, and sub-basin features. Specific examples of these changes are the development, implementation of best management practices, and changes in hydraulic infrastructure or operations. The model simulates flow from agricultural fields and natural wetlands to canals and reservoirs; land use and soil based processes, such as evapotranspiration and infiltration; groundwater flow in a multi-layer aquifer system; and surface water - groundwater interactions. The model serves to provide insight into the pathways and relative contributions of various mechanisms (e.g., channel/impoundment hydraulics, phosphorus storages, groundwater exchange) that contribute to the total phosphorus in the basin outflow.

BIO: Dr. Loinaz is a senior project engineer with over 15 years of experience in mathematical modeling of water quality, hydraulic and hydrologic systems, with emphasis on surface water and ground water interactions. Her experience comprises studies of a range of environments, including numerous Everglades Restoration projects.

Contact Information: Maria Loinaz, ADA Engineering, 215 Verne Street, Suite D, Tampa, FL, 33606, Phone: 727-698-7525, Email: mloinaz@adaeng.net

AN OPERATIONAL FORECAST MODEL FOR COASTAL WATER LEVELS

Joseph W. Long[1], *André van der Westhuysen*[2], *Jenna A. Brown*[1], *Hilary F. Stockdon*[1]
[1]U.S. Geological Survey, St. Petersburg Coastal and Marine Science Center, St. Petersburg, FL USA
[2]IMSG at NOAA/NWS National Centers for Environmental Prediction, College Park, MD USA

Predictions of total water levels, which are computed as the combination of astronomical tides, storm surge, and wave runup, are necessary to provide guidance on potential coastal erosion and flooding hazards. However, the wave runup component is presently absent from existing real-time meteorological and oceanographic forecast systems. While some tropical storm-specific forecasts of coastal hazards exist, they only consider the peak storm characteristics, do not resolve the time-varying combination of waves and water levels, and do not consider localized flooding and erosion that can happen during non-tropical or less extreme events. In response to this need, the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS) have partnered to create an operational modeling system that predicts total water level along coastal areas and therefore helps provide communities with timely coastal hazard warnings that cover a broad range of wave conditions.

The model has been successfully incorporated into an operational framework and is currently being implemented at five pilot Weather Forecast Offices (WFO's) along the U.S. Atlantic and Gulf coasts. Tides and subtidal water levels are provided by the Extratropical Surge and Tide Operations Forecast Systems (ESTOFS) and wave heights and periods are predicted using the Nearshore Wave Prediction System. Wave properties are output along the 20-meter contour and provide input for the empirical wave runup model developed by Stockdon et al. 2006. Beach slopes, also required by the wave runup model, are calculated by the USGS using lidar topographic data. The spatial and temporal uncertainty in total water level is also predicted. In this talk we also focus on the validation of the total water level predictions using remote sensing cameras located in some of the pilot areas. We assess the accuracy of the individual model inputs including wave height, period, and direction, and compare measured beach slopes to the beach slope characterization used in the operational framework. Finally, we relate these total water level forecasts to the prediction of coastal erosion hazards that impact infrastructure and ecosystems.

<u>BIO</u>: Dr. Long has over 14 years of experience developing numerical, probabilistic, and empirical models to simulate hydro- and morphodynamics in coastal environments. He has conducted numerous studies in a range of environments related to coastal vulnerability and storm-induced evolution of beaches and barrier islands.

<u>Contact Information</u>: Joseph W. Long, U.S. Geological Survey, St. Petersburg Coastal and Marine Science Center, 600 4th Street South, St. Petersburg, FL, USA 33701, Phone: 727-502-8024, Email: jwlong@usgs.gov

RECENT CHANGES IN NESTING PATTERNS OF ROSEATE SPOONBILLS IN THE EVERGLADES SUGGEST A RESPONSE TO SEA LEVEL RISE AND GLOBAL CLIMATE CHANGE

***Jerome J. Lorenz**, Michelle Robinson, Mike Kline and Peter Frezza*
Audubon Florida Everglades Science Center, Tavernier, FL, USA

In recent decades, the numbers of Roseate Spoonbills nesting in Florida Bay has been in decline. Most evidence for this decline implicates a reduction of productivity at lower trophic levels in the spoonbill's food web due to alterations in freshwater flow from the Everglades to Florida Bay caused by modern water management practices. Over the last decade, however, most of the declines in nest numbers in Florida Bay proper have been compensated for by increased nest numbers at two colonies in the wetlands north of Florida Bay. Furthermore, nest numbers at two other population centers, Merritt Island National Wildlife Refuge and Tampa Bay have declined with concurrent expansion of nesting activity in nearby coastal wetlands on the mainland. Nesting locations have increased from one prior to 1975 (Florida Bay) to three in the 1980's (Tampa Bay and Merritt Island NWR) to more than twenty throughout Florida and into Georgia and South Carolina. We present evidence that these movements can be best explained by a response of spoonbills to increased sea surface elevation and raising temperatures in the region. We present findings from mark/resight and satellite telemetry studies to demonstrate the movement of spoonbills away from the estuaries. Hydrologic and temperature data are presented to link the movement of nesting away from the estuaries to more inland coastal sites, with an emphasis on the movements within the Everglades water shed.

BIO: Dr. Lorenz is the State Research Director for Audubon Florida's Everglades Science Center and has studied southern Florida Ecosystems for more than 25 years with a focus on Florida Bay.

Contact Information: Jerry Lorenz, Audubon Florida, Everglades Science Center,115 Indian Mound Trail, Tavernier, FL, USA, 33070, Phone: 305-852-5318, Email: jlorenz@audubon.org

TARGETED ADAPTIVE MANAGEMENT TO INFORM CERP PROGRESS

***Andrew J. LoSchiavo**[1]*, *April Patterson, Gretchen Ehlinger, Agnes McLean, Steve Traxler, Laura Brandt, Fred Sklar, Patti Gorman, Jed Redwine*

[1]U.S. Army Corps of Engineers, Jacksonville District, FL, USA
[2]Everlgades National Park, Homestead, FL, USA
[3]U.S. Fish and Wildlife Service, Vero Beach, FL, USA
[4]U.S. Fish and Wildlife Service, Davie, FL, USA
[5]South Florida Water Management District, West Palm Beach, FL, USA

The Water Resources Development Act of 2000 required implementation of adaptive management (AM) principles to planning and implementation of the Comprehensive Everglades Restoration Plan (CERP). AM is a structured management approach to address uncertainties about restoration planning, design, and operations. Using AM enhances public confidence in management decisions by implementing an array of techniques developed by physical and social scientists. Hypothesis testing conducted by physical and biological scientists during operational tests, implementation of large scale physical models, and structured project monitoring design provides essential clarity when working in complex systems. Clearly framed scientific results become powerful social tools when linked to decision making. As science feeds back to a broad community of stakeholders, they become empowered to recognize when it is appropriate to adjust design and implementation of the restoration plan to improve the probability of restoration success.

Much progress has been made on developing guidance to implement AM. U.S. Army Corps of Engineers implementation guidance for WRDA 2007 Section 2039, the 2003 Programmatic Regulations for the Comprehensive Everglades Restoration Plan (CERP), and 2011 CERP Guidance Memorandum 56. A number of project-specific adaptive management plans have been developed and several have been implemented. All CERP AM plans address decision-critical uncertainties to inform future CERP planning and implementation. These plans are designed to keep the process of learning, communication, and strategic planning vibrant and relevant into the second and third decade of CERP implementation.

REstoration COordination and VERification (RECOVER) has taken the lead to kick off prioritization of AM strategies to inform CERP projects in the next 5 to 10 years based on the CERP project implementation schedule. Priority AM strategies must be directly related to achieving a CERP restoration goal or objective, inform restoration project decisions, and pose an important risk to achieving restoration success. One such example of a priority AM strategy comes from the Central Everglades Planning Project AM plan. The key uncertainty to address is the need to implement active vegetation management to jump start restoration succession associated with increased restoration flows in northern Water Conservation Area (WCA) 3A, WCA 3B, and in Everglades National Park. It is expected that without active vegetation management, restoration of degraded landscapes could take many decades instead of less than one decade. This presentation discusses the path forward to prioritize and implement new priority AM efforts to support immediate CERP implementation needs.

BIO: Mr. LoSchiavo has 16 years in natural resource management issues, and 9 years with Everglades restoration science, planning and implementation with a focus on adaptive management. He holds a master's in environmental management from Duke University (Durham, North Carolina) and Bachelor's of Science in Biology from Denison University (Granville, Ohio).

Contact Information: Andrew J. LoSchiavo, Restoration and Resources Section Chief, Environmental Branch, Planning Division, U.S. Army Corps of Engineers Jacksonville District, 701 San Marco Boulevard, Jacksonville, FL, 32207; Phone: 904-232-2077, Cell: 904-305-1421, Email: Andrew.j.loschiavo@usace.army.mil

CONCEPTUAL "SOLAR MARSH": COMBINED STORMWATER TREATMENT AREA AND ELECTRIC GENERATION.

J. William Louda
Florida Atlantic University, Boca Raton, FL, USA

Reasons: (a) Increasing demand for electrical power in southern Florida obviously parallels the quite large increases in population in this area promotes fossil fuel powered electrical generation which pollutes the atmosphere. (b) Natural gas (Palm Beach Co., West County aka 20 Mile Bend)) power plants contribute huge amounts of greenhouse gases (carbon dioxide and unburned hydrocarbons, methane) to the atmosphere. (c) Once solar plants are constructed, there will never be increases in fuel (sunlight) costs. (d) Placement over a filtering marsh allows for a combined use of valuable land: stores / cleans water, acts as a flow-way and provides electrical power.

Growth Management Advantage: Purchase of the agricultural lands south of the lake, as voted on by 78% of those voting on the Amendment #1 referendum, would get the landowners profits immediately and would remove these lands from any future development. Currently a bill is in the Florida Senate to actually do what the people voted for.

The "SOLAR MARSH" concept: What is proposed here, following the purchase of these lands, for South Florida Water management in conjunction with a power company (FP&L?) to construct an STA, or several, over which will be placed photovoltaic solar panels to generate electricity. Many solar panels are on the market today which pass either a certain percentage of all solar radiation or specific wavelengths. Proposed here is the use of solar panels which pass photosynthetically active radiation (PAR) such as Iriodin® SHR 870, a very translucent, neutral colored, multi-layer pigment. It was developed with a high transmission for "Photosynthetic Active Light" (400 to 700 nm); the light that plants need for photosynthesis. My own studies in the Everglades reveal that Everglades' periphyton produces excessive amounts quantities of sunscreen pigments since they receive enormous radiation (photon flux density). Obviously new engineering concepts would be needed to handle such things as panel and marsh upkeep. Having solar powered electrical generation in the area south of the lake would provide many new higher paying jobs for the people in that area.

BIO: Dr. Louda is a Research Professor specializing in microalgal pigments, water quality, algal blooms, climate change and overall environmental biogeochemistry. He teaches undergraduate and graduate courses in Environmental Chemistry. Past studies supported by the South Florida Water Management included periphyton and phytoplankton in Lake Okeechobee, the Everglades and Florida Bay.

Contact Information: Dr. J. William Louda, Department of Chemistry and Biochemistry and the Environmental Sciences Program, Florida Atlantic University, 777 Glades Road, Boca Raton, Florida, 33431. Phone: 561-297-3309. Email: blouda@fau.edu

HONING THE BLADE OF ACTIVE MARSH IMPROVEMENT: IS SEQUENCE IMPORTANT FOR CONTROLLING CATTAIL FOR REHABILITATION OF RIDGES AND SLOUGHS?

***Michael Manna*[1]**, *Sue Newman*[1], *Mark Cook*[1], *LeRoy Rodgers*[1], *Christen Mason*[1] *and Christa Zweig*[1]
[1]South Florida Water Management District, West Palm Beach, FL, USA

Habitat restoration efforts in the northern Everglades (WCA2A), have focused on methods to accelerate the recovery of cattail (*Typha domingensis* Pers.) impacted areas. Our early experimentation involved a spray-then-burn method using Glyphosate and Imazapyr. This resulted in vast submersed aquatic vegetation (SAV) /open-water marshes of *Chara* spp. within 2 years. Some experimental plots required no maintenance, whilst others needed additional treatment to maintain a competitive advantage against cattail; however that also resulted in the loss of wet prairie and SAV species. In contrast, five years after initial treatment we switched to Imazamox, a herbicide selective towards cattail. Using this herbicide we were able to maintain the established SAV community and support the development of wet prairie species. Similarly, desirable vegetation diversity and ridge and slough spatial structure were preserved when we applied Imazamox alone in dense cattail areas with limited remnant slough cover. Within two years, previously outcompeted sloughs were re-established and slough vegetation was prominent in once historic expanses. However, the treatment was not as effective as that observed in other, less nutrient rich, areas of the Everglades.

Currently, we are refining our treatment strategy, specifically, comparing the sequence of herbicide application with prescription burning. It is thought that burning before, as opposed to after, spraying, may provide better herbicide coverage and result in greater spatial control of cattail. Additionally, we have incorporated herbicide alone and prescription burning alone, as appropriate treatment controls. After plant community and wildlife usage are assessed, we will conduct a cost: benefit analysis to determine which active marsh improvement strategy should be used to recover ridge and slough communities and link them to tree islands, providing a network of productive wildlife habitat.

BIO: Michael Manna is a research ecologist with 18 years of experience in conducting, designing, and implementing Everglades research projects. He has extensive experience with plant taxonomy and ecology.

Contact Information: Michael Manna, Everglades Systems Assessment Section, South Florida Water Management District, Field Operations Center Bldg. #374, 8894 Belvedere Rd., West Palm Beach, FL 33411, USA, Phone: 561-753-2400, ext. 4578, Email: mmanna@sfwmd.gov

HOW WILL PERIPHYTON RESPOND TO WATER FLOW AND NUTRIENT LOADING CHANGES IN THE EVERGLADES?

Luca Marazzi[1], *Barry H. Rosen*[2], *Sue Newman*[3], *Evelyn Gaiser*[1], *Erik Tate-Boldt*[3], *Sarah Bornhoeft*[4], *and Joel Trexler*[4]

[1]Florida International University, Miami, FL USA
[2]United States Geological Survey, Orlando, FL, USA
[3]South Florida Water Management District, West Palm Beach, FL, USA
[4]Florida International University, North Miami, FL USA

Periphyton mats are complex systems including inorganic and organic matter, bacteria, algae, and infauna; as such, they are powerful indicators of wetland biogeochemistry, and food web dynamics. We present our most recent findings on algal community structure, aquatic ecosystem metabolism, and consumer dynamics in relation to freshwater flow and nutrients in Everglades periphyton. Short / long hydroperiod and oligotrophic / eutrophic sites host different algal communities with a higher proportion of cohesive / floating mats, respectively. The abundance, biomass and diversity of algae vary in space and time, and across hydroperiod and nutrient gradients; this has significant implications for the Everglades' food webs, as green algae and diatoms tend to be more edible than cyanobacteria. We demonstrate how different restoration scenarios are likely to cause significant changes in periphyton algal communities and biogeochemistry due to the effects of modified water depth and P concentrations. We discuss the implications of sheet-flow restoration for aquatic metabolism in relation to the ensuing changes in water quantity, velocity and quality, and vegetation dynamics. We introduce perspectives on how contrasting restoration and climate change scenarios may impact algal community structure, biogeochemistry, and food webs in the Everglades marsh waterscape.

<u>BIO</u>: Dr. Marazzi is a Postdoctoral Associate in Dr. Evelyn Gaiser's laboratory at Florida International University. He is a freshwater ecologist investigating patterns and drivers of diversity, biomass, and abundance of algae in subtropical wetlands; most recently he has been focusing on dominance structure changes in the Everglades periphyton algal communities in relation to phosphorus and hydrology.

<u>Contact Information</u>: Luca Marazzi, Southeast Environmental Research Center, Florida International University OE-148 11200 SW 8th Street, Miami 33199, FL, USA, Phone: 305-348-1592, Email: lmarazzi@fiu.edu

DO DAYLENGTH AND DESICCATION AFFECT SPROUTING OF CRESTED FLOATINGHEART RAMETS?

***Ian J Markovich**, Lyn A Gettys and Kyle L Thayer*
University of Florida FLREC, Davie, FL, USA

Crested floatingheart (*Nymphoides cristata*) is an attractive aquarium and water garden plant that escaped cultivation in the 1990s. It has invaded Florida's aquatic systems and has caused such severe impacts that the species is now listed as a noxious weed by FDACS. Crested floatingheart reproduces mostly through the production of ramets, which are clusters of rhizomes produced at each juncture of leaf and petiole. Previous research showed that ramets buried under as little as 2 cm of substrate failed to sprout (and therefore did not produce new plants) during an 8-week culture period, but little is known about how burial duration affects sprouting. These same studies also showed that desiccation prevented sprouting, but the shortest "dry" interval examined was 1 month. In addition, there are no reports on the effects of daylength on sprouting. I will outline the results of research projects conducted at the UF IFAS FLREC that were designed to provide information about the effects of burial duration, short-term desiccation and daylength on sprouting of crested floatingheart ramets.

BIO: Ian Markovich has an Associate's degree from Florida Gulf Coast University and is working on a bachelor's degree in Environmental Science at Broward College. He works in Dr. Lyn Gettys' Aquatic Plant Science Lab at the University of Florida FLREC where he conducts undergraduate research and assists with lab operations.

Contact Information: Ian Markovich, University of Florida IFAS FLREC, 3205 College Avenue, Davie, FL, USA 33314, Phone: 954-495-1768, Email: ijmarkovich@ufl.edu

INTERPRETING FRESHWATER PALEOECOLOGICAL STUDIES TO BETTER UNDERSTAND THE IMPACT OF 20TH CENTURY ALTERATIONS ON THE HYDROLOGY AND SALINITY IN EVERGLADES NATIONAL PARK

***Frank E. Marshall*[1]**, *Christopher E. Bernhardt*[2], *G. Lynn Wingard*[2]
[1]Cetacean Logic Foundation, New Smyrna Beach, Florida, USA
[2]United States Geological Survey, Reston, Virginia, USA

Prior to large-scale drainage projects beginning around 1900 CE (Common Era), the Greater Everglades Ecosystem in southern Florida consisted of a vast hydrologically connected system that began in the Kissimmee watershed and continued southward to the estuaries and coasts. Research to-date has shown that altered upstream hydrology has greatly impacted the natural ecology of the downstream freshwater wetlands and the receiving estuaries. Restoration of the remaining ecosystem within Everglades National Park (ENP) is now the focus of a multi-decadal, multi-agency state and Federal effort guided by the Comprehensive Everglades Restoration Plan (CERP). Yet questions remain about the definitive targets for Everglades restoration. Previous studies in Florida Bay successfully used estuarine benthic assemblages from cores as proxies to estimate pre-drainage salinity and infer the needed upstream freshwater hydrology to obtain those salinities. These results have been used for the purpose of developing CERP salinity performance measures for Florida Bay.

The goal of this study was to determine if freshwater paleoecological data would support the previous estuarine core results. The pollen assemblages of three freshwater wetland cores were analyzed. Exotic pollen (*Casuarina*) was used as a biostratigraphic marker to indicate the circa 1900 CE horizon. Pollen assemblages were interpreted with the aid of cluster analysis. Modern data on habitat preference were used to characterize the circa 1900 CE hydroperiod and water depth conditions. These results were used to constrain the annual variability of water depth and hydroperiod in the region of the three freshwater wetland sediment cores using bias-adjusted output from a retrospective hydrologic model, the Natural System Model version 4.6.2, as the base data.

These simulated freshwater wetland paleo-based data were then used as inputs to a system of existing and newly-created regression models to extend the pre-drainage hydrologic conditions to other freshwater wetland areas throughout ENP and to estimate the pre-drainage salinity throughout Florida Bay, the tidal mangrove rivers, and locations in Whitewater Bay. The freshwater flows into ENP across Tamiami Trail needed to establish the paleo-based hydrologic and salinity conditions in ENP have also been estimated. These freshwater paleoecological results were then compared to the simulated salinity conditions from previously published estuarine paleoecological studies. The outputs of these coupled paleo-based analyses support the need for increased upstream freshwater flow to effectively restore more natural salinities. The results of this research can be used to establish and coordinate hydrology and salinity performance measures and targets for Everglades restoration by the Southern Coastal Systems and Greater Everglades Sub-teams of RECOVER (CERP's restoration science organization), and to assess the progress towards Everglades restoration.

BIO: Frank Marshall, PhD of New Smyrna Beach FL is a coastal hydrologist focusing on statistical analysis and modeling. His areas of research include hydrology, salinity, water quality, climate change, sea level rise, ecosystem services for beaches and estuaries, and coupling of paleoecological data and statistical models to simulate past conditions.

Contact Information: Frank Marshall, Cetacean Logic Foundation, New Smyrna Beach FL USA 32169. Phone: 386 451 9381.
Email: clfinc@earthlink.net.

PREY AVAILABILITY OF WADING BIRDS IN INTERTIDAL SYSTEMS

***Marisa T. Martinez*[1]**, *Emilie R. Kohler*[1], *Dale E. Gawlik*[1], *and Stephanie Romañach*[2]
[1]Florida Atlantic University, Boca Raton, FL, USA
[2]U.S. Geological Survey, Fort Lauderdale, FL, USA

Prey availability, a composite variable representing the abundance of prey as well as the vulnerability of prey to capture, is shown to strongly affect wading bird habitat selection, physiology, and reproduction. In intertidal systems hydrological fluctuations influence the vulnerability of prey to capture by wading birds. The little blue heron (*Egretta caerulea*) is an effective indicator of foraging habitat quality for wading birds because it is restricted to a narrow spatial and temporal range of foraging habitat and is sensitive to changes in hydrology and prey availability. We investigated prey availability for little blue herons in intertidal systems by evaluating hydrologic and habitat characteristics that generate high densities of aquatic prey. We measured water depth, percent submerged aquatic vegetation (SAV) cover, and density of aquatic fauna using throw-traps at random locations within the lower Florida Keys (Great White Heron National Wildlife Refuge; GWH; n=74) and Florida Bay, (Everglades National Park; ENP; n= 51). Sampling occurred on mud flats at low tide when water depth was $\leq$ 35 cm. Prey density was significantly higher (t=4.02, df=35, p<0.0001) at GWH (63.59 prey/m^2 $\pm$ 46.46) than at ENP (26.60 prey/m^2 $\pm$16.07). Water depth and percent SAV cover were higher at GWH locations (20.7 cm $\pm$ 5.6; 78% $\pm$ 24.1%) than at ENP locations (17.5 cm $\pm$ 7.8; 67% $\pm$ 34.4%, respectively). Prey density showed a positive, albeit weak, relationship with water depth and SAV cover at both study areas (R^2<0.2). Prey availability is likely not influenced by a single parameter but by a combination of hydrologic, habitat, and physical attributes. These data will be the basis for a model that predicts prey availability in an intertidal system using an information theoretic framework. Our results will provide resource managers with insight as to which habitat variables can be managed to promote wading bird population sustainability.

BIO: Marisa T. Martinez is a graduate research assistant pursuing her Ph.D. under the advisement of Dr. Gawlik at Florida Atlantic University. She received her M.S. at Texas A&M University in Wildlife and Fisheries Science and her dual B.S. at Cornell University in Natural Resources and Animal Science.

Contact Information: Marisa T. Martinez, Department of Integrative Biology, Florida Atlantic University, 777 Glades Rd., Boca Raton, FL, USA 33431, Phone: (201) 463-3138, Email: marisamartin2015@fau.edu

THE EFFECTS OF COLONY STRUCTURE AND NEST POSITION ON THE NESTING SUCCESS OF WADING BIRDS

***Jenna C. May**, David A. Essian, and Dale E. Gawlik*
Florida Atlantic University, Boca Raton, FL USA

When food is not limiting, competition for quality nesting space can constrain densities of breeding birds. Nesting sites of high quality provide structural support for nests as well as to offer more effective protection against predators and adverse weather conditions. Anthropogenic influences can alter the structure and composition of vegetation available for nest sites, thereby providing birds with novel habitat. During the 2015 and 2016 breeding seasons, we monitored 110 Great Egret *(Ardea alba)* nests and 229 small heron (Tricolored Heron *(Egretta tricolor)* and Snowy Egret *(Egretta thula)*) nests at Lake Okeechobee, Florida, USA. Data on nest fate, colony structure, nest position, weather and number of young fledged were recorded. Daily survival rates (DSR) and fledgling production were analyzed using the logistic-exposure method and generalized linear models with fixed and random effects. An information-theoretic approach was conducted using Akaike Information Criterion (AIC) to investigate competing models.

Small heron fledgling production was positively associated with temperature and negatively associated with rainfall during the dry season (βTemperature = 0.46, 95% CI = 0.69-0.72; βRain =- 0.21, 95% CI = -0.34- -0.08). Great Egret fledgling production was positively associated with temperature (βTemperature = 0.24, 95% CI = 0.04-0.44), and DSR for Great Egrets was positively associated with dry season rainfall and distance to canopy (βRainfall = 1.11, 95% CI = 0.13-1.99; βCanopy = 1.32, 95% CI = 0.08-1.84). Increased distance from the canopy edge can provide Great Egret nests with a buffer against high winds, whereas warmer temperatures reduce energy demands from thermoregulation and can increase prey activity and production. High rainfall increases water levels, which could benefit nesting Great Egrets if they support larger prey or exclude competition from short-legged waders.

Model selection showed no clear relationship between DSR and habitat structure or nest position for small herons and Great Egrets during the incubation period and small herons during the hatchling period. One possible explanation for the lack of evidence supporting habitat structure and nest position effects on the nesting success is that there was decreased food availability on-lake in 2016. That year was characterized by exceptionally high dry season water levels as a result of El Niño conditions. Thus, there was a limited recession of water levels that concentrate aquatic animals into shallow pools of vulnerable prey items, a known driver of wading bird nesting. The availability of food resources within close proximity of nests is important for supporting the energetic demands of reproductive processes and affects nest survival.

BIO: Jenna May is a master's student at Florida Atlantic University. A majority of her field work experience has occurred in South Florida, including Lake Okeechobee, the Everglades, the Big Cypress area, and the Florida Keys. Her interests lie in wetland ecology and habitat restoration.

Contact Information: Jenna May, Environmental Science Program, Department of Biological Sciences, Florida Atlantic University, Boca Raton, FL, USA 33431, Phone: 561-297-0671, Email: mayj@fau.edu

FUNCTIONAL AND COMPOSITIONAL RESPONSES OF PERIPHYTON MATS TO SIMULATED SALTWATER INTRUSION IN THE SOUTHERN EVERGLADES.

***Viviana Mazzei*[1]**, *Evelyn E. Gaiser*[1,2], *John S. Kominoski*[1,2], *Benjamin J. Wilson*[1], *Shelby M. Servais*[1], *Tiffany Troxler*[1,2]

[1]Department of Biological Sciences, Florida International University, Miami, Florida, USA
[2]Southeast Environmental Research Center, Miami, Florida, USA

Saltwater intrusion into freshwater coastal wetlands is an urgent problem caused by climate change and water management practices. In the Florida Everglades marine water intrusion, caused by sea level rise and reduced freshwater flows from upstream, is the major contributor to elevated salinity in this freshwater wetland. Intrusion of marine water also delivers excess phosphorus (P) into this naturally oligotrophic landscape, which, in combination with elevated salinity, results in biogeochemical and ecological consequences that are expected to greatly affect the carbon (C) storage capacity of this wetland. Periphyton, mat-forming benthic algal communities, are a ubiquitous component of the Everglades ecosystem and play an important role in C storage, as well other ecological processes, but are extremely sensitive to changing biogeochemical conditions such as salinity and excess nutrients. We experimentally tested effects of elevated salinity on periphyton from low-P freshwater (FW) and higher-P brackish-water (BW) wetlands. We hypothesized that increased salinity, and accompanying elevated P, would change the species composition of periphyton resulting in a replacement of calcareous, cohesive mats, with a higher-C storage capacity, to filamentous-film mats with lower-C storage capacity, measured as net ecosystem productivity (NEP).

Following the first salinity dosing, treatment chambers experienced decreased periphyton NEP relative to controls at both the FW (0.55-1.079 mg C g^{-1} AFDM hr^{-1}) and BW wetlands (0.055-0.384 mg C g^{-1} AFDM hr^{-1}). After one year of dosing, NEP remained lower in treatments versus control at the FW site but not the BW site. Similarly, elevated salinity decreased the carbon content of the periphyton mats at the FW site after month 1 of dosing and remained depressed at month 12. The total P and total nitrogen (N) content of periphyton mats were lower with elevated salinity in FW wetlands at both sampling times but no effect of salt addition on nutrient content was observed in BW wetlands. Freshwater periphytic diatom communities began to diverge from the control after the first saltwater dosing and continued to deviate more strongly after month 12 of dosing. Brackish water diatom communities deviated strongly from controls after the first saltwater dose but reverted back to a community more closely resembling that in the controls at month 12. These results suggest that periphyton communities in BW wetlands have a higher resilience to elevated salinity than calcareous periphyton mats in FW wetlands. These communities respond to simulated saltwater intrusion with rapid and sustained shifts in algal community composition that are likely linked to the decreased production, carbon storage capacity, and nutrient content of the FW periphyton as a result of salt stress. Rapid response of periphytic diatom communities makes them a powerful tool to track and predict even short-term exposure of FW marshes to saltwater intrusion.

Contact Information: Viviana Mazzei, Department of Biological Sciences, Florida International University, 11200 SW 8th Street, Miami, FL 33199 USA. Email: vmazz001@fiu.edu

A SCIENTIFIC FRAMEWORK FOR A SIMPLIFIED CONCEPTUAL APPROACH FOR EARLY DETECTION, RAPID RESPONSE AND REMOVAL OF INVASIVE WILDLIFE: REMOVING VEILED CHAMELEONS (*CHAMAELEO CALYPTRATUS*) FROM PALM BEACH COUNTY

Frank J. Mazzotti[1]*, Laura A. Brandt,*[2] *Mike Cherkiss*[3]*, Jenna M. Cole*[1]*, Sarah K. Cooke*[1]*, Jennifer Ketterlin Eckles*[1]*, Mike R. Rochford*[1]*, and Hardin Waddle*[4]

[1]University of Florida, Fort Lauderdale Research and Education Center, Davie, FL, USA
[2]U.S. Fish and Wildlife Service, Davie, FL USA
[3]U.S. Geological Survey, Wetland and Aquatic Research Center, Davie, FL USA
[4]U.S. Geological Survey, Wetland and Aquatic Research Center, Lafayette, LA USA

When alien species become introduced or established, early detection and rapid response (EDRR) efforts increase the likelihood that invasions will be successfully contained or eradicated while populations are still small and localized. In recognition of their value, EDRR programs have proliferated since 2000. These EDRR programs have some common features such as components (parts) and stages (actions). These actions have been incorporated into a simplified conceptual approach as part of the Everglades Invasive Reptile and Amphibian and Monitoring Program. Here we add a scientific framework to the conceptual approach to insure that the best science is applied in a manner which is systematic, consistent, and can be replicated. To accomplish this, we divide the EDRR process into an action or removal phase and a monitoring and evaluation phase. The action or removal phase constitutes the treatment of the alien species and the monitoring or evaluation phase determines response to treatment. Important questions that need to be answered during monitoring are: how can we infer absence and how confident can we be in that inference? With estimates of the probability of detection we can calculate a minimum number of surveys needed to infer absence for a given level of confidence, for example 90% or 95%. Probability of detection can be estimated as part of an effort to model occupancy. Efforts to estimate occupancy and detection have been complicated in previous studies where an invasive species were always removed on sight. Removing individuals violates the assumption of a closed system necessary for occupancy modeling. Hence we do not know how reliable our estimates of probability of detection have been.

In this case study, we have an opportunity to model occupancy and detection prior to removal of a new population of Veiled Chameleons in Palm Beach County. We will then apply the probability of detection to estimate how many surveys are needed to infer absence with 95% confidence. We will report on the results of this effort as well as discuss important caveats such as the fact that that these surveys are good for non-hatchling chameleons and if chameleons have nested it is possible that eggs are in the ground, in diapause, and will hatch this summer requiring additional surveys to fully eradicate the species.

BIO: Frank Mazzotti is a Professor of Wildlife Ecology at the University of Florida.

Contact Information: Frank J. Mazzotti, University of Florida, 3205 College Ave, Davie, FL, USA 33314, Phone: 954-577-6338, Email: fjma@ufl.edu

BURMESE PYTHONS AND URBANIZATION SHAPE THE MESO-MAMMAL COMMUNITY ACROSS THE EVERGLADES

Brian E. Reichert[1], *Adia R. Sovie*[1], *Brad J. Udell*[1], *Kristen M. Hart*[2], *Rena R. Borkhataria*[3], *Mathieu Bonneau*[1], *Robert Reed*[4], ***Robert McCleery***[1]

[1]University of Florida, Gainesville, FL, USA
[2]U.S. Geological Survey, Davie, FL, USA
[3]University of Florida, Belle Glade, FL, USA
[4]U.S. Geological Survey, Fort Collins, CO, USA

Burmese pythons (*Python molurus bivittatus*) have been an established invasive predator in the Greater Everglades Ecosystem (GEE) for at least 20 years. Recent studies suggest that Burmese pythons are clearly linked to recent declines in native marsh rabbits (*Sylvilagus palustris*) and there is some evidence suggesting that pythons may be causing declines of other meso-mammals throughout the GEE. However, there are a host of additionally factors that might explain the declines of mammals in the GEE. In particular, the GEE has seen increased human development, habitat changes and drastic alteration in water flow all of which could help shape meso-mammal communities. We are interested in elucidating the drivers the changing meso-mammal community across the GEE. Using trip cameras and scat searches we sampled 113 randomly placed plots throughout the GEE. We then constructed a multispecies occupancy model to assess the biotic and abiotic factors influencing the species distributions and community structure of meso-mammals in the GEE.

Python density had significant negative effects on all observed species except coyotes for which the effect was also negative but not significant. Species richness was lowest near the epicenter of the python invasion where estimated python densities are the highest in the region. Based on our results, python density had significant negative effects on local species richness and severely altered community composition. Surprisingly, we found evidence for an antagonistic interaction between pythons and urbanization. Specifically, distance to urbanization reduced impacts of increasing python density on species richness and community dissimilarity due to species loss. Accordingly, distance to urbanization also increased the rate of turnover despite high densities of pythons. The python induced loss and change to meso-mammal communities across the GEE is probably causing a massive rearrangement of the food web, losses in ecosystem function, and complex and unpredictable cascading effects.

BIO: Dr. McCleery is an Associate Professor in the Department of Wildlife Ecology and Conservation at the University of Florida. His research focuses primarily on understanding how mammals respond to anthropogenic driven changes and how to maintain wildlife communities and populations that foster healthy ecosystems. He has extensive experience researching the impacts of invasive Burmese pythons on mammal species in the Everglades.

Contact Information: Robert McCleery, Wildlife Ecology and Conservation, University of Florida, 110 Newins-Ziegler Hall, Gainesville, FL, USA 32611, Email: themccleerylab@gmail.com

SPATIAL VARIABILITY IN PRODUCTION AND RELEASES OF BIOGENIC GASES FROM TWO SUBTROPICAL WETLAND ECOSYSTEMS IN CENTRAL FLORIDA IS REVEALED USING HYDROGEOPHYSICAL METHODS

***Matthew D. McClellan**, and Xavier Comas*
Florida Atlantic University, Davie, FL, USA

Spatial Distribution of biogenic gas (CH4, CO2) production within peat soils remains highly uncertain despite the many studies surrounding peatland greenhouse gas production within the recent past. Majority of these studies have been focused in northern boreal peatlands leaving tropical and subtropical peatlands vastly understudied. This study implements hydrogeophysical methods to investigate the spatial variability in biogenic gas accumulation and release in two 0.027 m3 peat monoliths from two different wetland ecosystems in central Florida (sawgrass peatland and a wet prairie) at both the lab and field scale. Gas content variability (i.e. build-up and release) within the peat matrix was estimated over a period of five months using a series of high frequency (1.2 GHz) ground penetrating radar (GPR) transects along each sample about three times a week. An array of gas traps (eight per sample) fitted with time-lapse cameras were used in order to constrain GPR measurements as well as capture gas releases at 15 minute intervals. CH4 and CO2 content of the gas collected in the gas traps was analyzed with a gas chromatograph. Cores were collected under each gas trap after GPR measurements concluded in order to analyze the peat soil for porosity and bulk density. The aim of this study is to investigate the spatial variability of biogenic gas production at the lab and regional scale and how these differences are potentially related to structural changes within the peat matrix. This work has implications for better understanding natural greenhouse gas production as well as carbon dynamics within subtropical peat soils.

<u>Contact Information</u>: Matthew D. McClellan, Department of Geosciences, 3200 College Ave, DW 339, Florida Atlantic University, Davie, FL, 33314, USA, Email: mmcclellan2013@fau.edu

DROUGHT CONDITIONS SET UP THE 2015 COLLAPSE OF FLORIDA BAY SEAGRASS

***Amanda A. McDonald**, Stephen P. Kelly, and Christopher J. Madden*
South Florida Water Management District, West Palm Beach, FL, USA

In the late summer of 2015, seagrasses in central and western Florida Bay started to die rapidly in a pattern reminiscent of the large seagrass die-off of the late 1980's that triggered a push to restore flows through the Everglades to Florida Bay. The hydrologic, meteorological, and salinity monitoring programs that have been established since the 1980's provide a clearer picture of the conditions leading up to and during this recent die-off event and allow a closer examination of the contributing factors. Water level, rainfall, temperature, creek flow, and salinity data from established monitoring platforms maintained by Everglades National Park, South Florida Water Management District, and United States Geological Survey were used in this analysis.

Low rainfall beginning in the summer of 2014 and continuing through the summer of 2015 led to record low creek flows into Florida Bay in the summer of 2015 and record high salinities. Coupled with water temperatures that were persistently above the 75th percentile, the high salinities exacerbated the physiological stress on the dominant seagrass of the region, *Thalassia testudinum* or turtle grass, pushing it to the limit of its endurance. Cascading impacts from the loss of benthic habitat can be expected to continue throughout the next few years.

BIO: Amanda A. McDonald is an ecological modeler who has analyzed Florida Bay data for more than 10 years and currently serves as a regional coordinator for the Southern Coastal Systems of the REstoration, COordination, and VERification (RECOVER) program.

Contact Information: Amanda McDonald, Everglades System Assessment Section, South Florida Water Management District, 3301 Gun Club Rd, West Palm Beach, FL, USA 33406, Phone: 561-753-2400 x4648, Email: amcdonal@sfwmd.gov

DESIGNING A SOFTWARE FRAMEWORK FOR HYDROLOGIC FORECASTS AND MODELING SPECIES RESPONSES

***Mark McKelvy*[1]*,** *Kevin Suir*[1], *James Beerens*[2], *Leonard Pearlstine*[3], *Gregg Reynolds*[3]

[1]U.S. Geological Survey, Lafayette, LA, USA
[2]U.S. Geological Survey, Davie, FL, USA
[3]National Park Service, Homestead, FL, USA

Ecological restoration of the Greater Everglades has been ongoing for over two decades and faces many challenges from financial and political to scientific. In the scientific realm, natural resource managers rely on the research of environmental scientists to help inform their decisions, which will have an impact on a variety of species in the region (e.g., threatened, endangered, invasive). Scientists build predictive models to indicate how species may respond to hydrologic changes across the landscape and through time. The Joint Ecosystem Modeling (JEM) community provides a suite of ecological modeling software to process hydrologic data, generate predicted responses, and provide visualizations to inform decision-makers.

JEM software such as Wader Distribution Evaluation Modeling (WADEM), which estimates wading bird nest effort and success, or the Alligator Production Probability model, allows users to evaluate various hydrologic restoration scenarios and assess current, real time conditions across the landscape for the species of interest. A key, but missing component, however, is a software package that integrates the ability to look into the near-term future (1 to 6 months) and generate plausible scenarios of hydrologic conditions and the predicted species responses. A semi-automated mechanism for running ecological models against those scenarios can help determine, across multiple species, what the expected cost/benefit will be if various conditions are met.

Ecologists and computer scientists in the JEM community are collaborating on a tool, Ever4Cast, that will integrate a probabilistic hydrologic scenario-generation component and, as separate modules, parts of existing JEM models to help determine bounds on ecological responses in the near-term future. This software incorporates NOAA precipitation forecasts and past hydrologic patterns to generate a range of possible hydrologic futures from lower to higher water levels, and from lower to higher variability of change in water levels over time. We introduce this new software, highlight the challenges in its progress, discuss design decisions and consider future development efforts.

BIO: Mark McKelvy is a Computer Scientist at the USGS Wetland and Aquatic Research Center (WARC). He serves as a lead application developer in the USGS WARC's Advanced Applications Team. Mark has developed decision-support applications, ecological models, and visualization software for the Joint Ecosystem Modeling (JEM) community, State of Louisiana, and other partners.

Contact Information: Mark McKelvy, Wetland and Aquatic Research Center, U.S. Geological Survey, 700 Cajundome Blvd, Lafayette, LA 70506 USA, Phone: 337-412-4649, Email: mckelvym@usgs.gov

UNDERWATER ACOUSTIC MONITORING IN U.S. NATIONAL PARKS

***Megan F McKenna*[1]*, Christopher Garsha[2], Erik Stabenau[3], Christine Gabriele[4], Timothy Clark[5], Clayton Pollock[6], Brinnen Carter[7], Samantha Bietsch[2], Abigail Crowder[2], and Eva DiDonato[8]*

[1]National Park Service- Natural Sounds and Night Skies Division
[2]Colorado State University- Fish, Wildlife, and Conservation Biology Department
[3]Everglades National Park
[4]Glacier Bay National Park
[5]National Park of American Samoa
[6]Buck Island Reef National Monument
[7]Sitka National Historic Park
[8]National Park Service- Ocean and Coastal Resource Branch

National parks protect unique soundscapes as core resources. Inventorying park sounds and monitoring changing sounds contribute to protecting park soundscapes, cultural landscapes, wilderness, wildlife habitat and communication, and ecological processes— including predator-prey interactions. The first step to protecting the acoustic environment of a park is to characterize it accurately. Monitoring trends in acoustic conditions— including bio-acoustic activity— can then provide evidence of changing conditions that park managers can act upon. An underwater passive acoustic monitoring system in Glacier Bay National Park has been in place for over fifteen years, providing data on the status and trends of underwater noise from motorized vessels and the presence and seasonality of marine species, including humpback whales, killer whales, and harbor seals, as well as baseline data for the Gulf of Alaska region. In 2014, NPS partnered with the National Oceanic and Atmospheric Administration to build and deploy two ocean noise reference stations within NPS waters as part of a larger national network. The network represents the first large-scale effort to monitor long-term changes and trends in underwater sound spanning vast swaths of U.S. waters. The NPS sites at National Park of American Samoa and Buck Island Reef National Monument provide critical baseline information on acoustic conditions to compare across the network and over time. The NPS ocean noise reference stations were also selected to detect the occurrence and seasonality of marine mammals and levels of motorized boat traffic to inform park management. Sitka National Historical Park recently deployed a system as an exploratory study to record sounds in the harbor and serves as a pilot project to build a library of underwater sounds in U.S. national parks. Everglades National Park paired underwater acoustic monitoring with measures of oceanographic conditions (e.g. salinity) in Florida Bay to determine if bio-acoustic activity can provide early indicators of changes in ecosystem conditions and possibly recovery from climatic or anthropogenic events. Collectively, these underwater acoustic monitoring efforts are important steps towards developing relevant methods and reference libraries for monitoring and protecting park soundscapes using passive acoustic sensors.

BIO: Dr. McKenna is an acoustic biologist and assists parks with acoustic monitoring and soundscape management. She has extensive experience collecting and analyzing passive acoustic data in a variety of aquatic and terrestrial habitats. She has participated in national and international committees to understand and manage acoustic impacts.

Contact Information: Megan F McKenna, National Park Service, Natural Sounds and Night Skies Division, 1200 Oakridge Dr., Fort Collins, CO, USA 80521, Phone: 970-267-2123, Email: megan_f_mckenna@nps.gov

A RESEARCH PLATFORM IN THE FLORIDA EVERGLADES FOR INVESTIGATING THE INTERACTIONS AMONG HYDROLOGY, WATER MANAGEMENT AND ORGANIC CARBON CYCLING

***Christopher W. McVoy*[1]**, *James T. Brock*[2], *and John S. Kominoski.*
[1]Long Slough Research, Lake Worth FL, USA
[2]Desert Research Institute, Reno, NV USA
[3]Florida International University, Miami, FL USA

The "Floccometer" is a long term ecohydrological research facility sited at a location that most closely resembles the predrainage Everglades in terms of water depths, water chemistry, soils, vegetation, ridge and slough geomorphology, unconsolidated organic sediments ("floc") and (in part) surface flows. Additionally the site was chosen to provide an experimental flow treatment as the large S-12-C gates, 1.5 km downstream, are annually opened and closed. The solar-powered, web-tied site, funded by the South Florida Water Management District, includes two main components: a fixed position platform and a robotic X-Z system for precisely positioning a submersible instrument array ("pod"). The infrastructure platform supports continuous contextual measurements of physical driving forces: meteorology, stage and flow as well as a fixed position vertical thermistor array. Repeatable, sub-millimeter vertical positioning of the pod allows profiling of the full water column including long term time series measurements of the elevations of various interfaces (air-water, water-floc, and floc-peat), as well as temperature and dissolved oxygen. A system of elevated rails will provide replicability along a 12-m transverse slough transect.

We are examining mechanisms for resuspension of the floc including storm events, thermal inversions within the water column, gas production through photosynthesis and respiration, and bioturbation. The vertical array of thermistors has demonstrated the occurrence of thermal inversions. The instrumented platform will enable quantification of changes in the floc layer thickness and depth-integrated water column metabolic activity along the 12-m ridge-slough transect. Aquatic ecosystem metabolism, in water and in flocc, has been quantified in relation to seasonal and event-based driving forces.

Continuous measurements of aquatic ecosystem metabolism in the ridges and sloughs have been conducted over the annual cycle of wet and dry season. Declining dry-season water levels have decreased ridge heterotrophy due to increased light penetration and increased slough heterotrophy due to increased floc density.

<u>BIO</u>: Dr. Christopher McVoy is an ecohydrologist with 20 years of involvement in Everglades research, particularly the original, predrainage conditions once present and the processes responsible for past and present geomorphology. Formerly with the South Florida Water Management District, Dr. McVoy is also a three term Lake Worth city councilperson.

<u>Contact Information</u>: Christopher McVoy, Long Slough Research, 1514 15th Ave N, Lake Worth, FL USA 33460, Phone: 561-398-6115, Email: cmcvoy@gmail.com

ENVIRONMENTAL DNA (EDNA) DETECTION OF BURMESE PYTHONS IN THE ARM LOXAHATCHEE NATIONAL WILDLIFE REFUGE AND SOUTHEAST FLORIDA USING STATE-OF-THE-ART DROPLET DIGITAL PCR

Gaia Meigs-Friend[1], *Robert M. Dorazio*[1], *Kristen M. Hart*[2], *Brian J. Smith*[2], *Hayley Crowell*[2], *Michael Cherkiss*[2], *Mathew Denton*[2], *and Margaret E. Hunter*[1]

[1]US Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA
[2]US Geological Survey, Wetland and Aquatic Research Center, Davie, FL, USA

Patterns of occupancy for invasive species can be determined using environmental DNA (eDNA). In south Florida, invasive Burmese pythons occupy thousands of square kilometers of mostly inaccessible habitats and are detrimental to native species. Detection of Burmese pythons by traditional methods such as trapping, visual searching, or detection dogs, is low, thus eDNA may be a method for identifying areas of occupancy for constrictor snakes. Environmental DNA is shed into the environment through feces, mucus, saliva, or skin cells and was collected when present for our study from environmental water samples. We adapted a quantitative PCR eDNA assay for droplet digital PCR, a state-of-the-art method that improves accuracy and sensitivity. We also implemented a model specifically developed for eDNA estimation of detection and occurrence probabilities. This model is used to assess the proportion of sites occupied by a species, correcting for imperfect detection, as well as assess the efficacy of the detection method. From August 2014 to September 2016, Arthur R. Marshall Loxahatchee National Wildlife Refuge and surrounding areas were surveyed five times at 114 sites for Burmese python eDNA. Positive Burmese python eDNA was detected in approximately 35% of the sites. Using eDNA assay replicate samples, occurrence and detection probabilities were calculated for these sites. While our eDNA testing has shown the presence of pythons in these areas since 2014, the first confirmed sighting of a Burmese python in the Loxahatchee National Wildlife Refuge occurred this September. As this incident indicates, the effectiveness of traditional sighting methods has been limited. Environmental DNA methods will continue to inform range limits and expansion pathways for Burmese pythons in south Florida, as well as laying the foundation for potentially assessing the efficacy of removal efforts for this species.

<u>BIO</u>: Ms. Meigs-Friend is a biologist with over 10 years working with the U.S. Geological Survey. Ongoing research projects involve genetic analysis of a variety of invasive and endangered species, and most recently use of eDNA to study these species.

<u>Contact Information:</u> Gaia Meigs-Friend, U.S. Geological Survey, Wetland and Aquatic Research Center, 7920 NW 71st Street, Gainesville, FL 32653 USA, Phone: 352-226-9015, Email: gmeigs-friend@usgs.gov

MOVEMENTS OF SNAIL KITES *(ROSTRHAMUS SOCIABILIS)* TRACKED BY SATELLITE, 2007-2016: HABITAT ASSOCIATIONS, MULTIPLE RESIDENCE AREAS, AND SUSTAINABLE MANAGEMENT OF A RANGE-WIDE HABITAT NETWORK

Kenneth D. Meyer *and Gina M. Kent*
Avian Research and Conservation Institute, Gainesville, FL, USA

The U.S. population of Snail Kites, limited to peninsular Florida, declined substantially and became federally listed as Endangered in 1967 following massive hydrologic and agricultural changes to the Greater Everglades and its headwaters. Since 2007, we have collected over 100,000 satellite-telemetry locations for 22 adult Snail Kites. This study has documented frequent movements of individuals over large portions of the species' Florida range, as did a VHF radio tracking study by Bennetts and Kitchens in the 1990s. Such tracking results, combined with the rapid establishment of large, productive breeding efforts in 2015 and 2016 on Lake Okeechobee and a newly created impoundment in central Florida, make the case that Snail Kites are well-adapted to quickly detect and exploit high-quality feeding conditions anywhere in their range, even when novel or ephemeral, as local changes in feeding conditions demand. Our large time-stratified satellite dataset, which is unique for its long duration, high detection probability, and low observer bias, provides a valuable basis for management planning. The actual distribution of Snail Kites within Florida can be described as a network of discrete areas that may or may not be occupied at any given time. Use of these relatively small, disjunct areas appears to be driven by the availability prey, i.e., native and exotic apple snails (*Pomacea* species). Year-round, only 43% of the satellite locations (45% during the breeding season) were within the managed and monitored natural wetlands representing the Snail Kite's historic distribution. The rest of the time, occupied areas consisted of water-management canals, agricultural drainage ditches and impoundments, borrow pits, retention ponds, storm-water treatment areas (STAs), and remnants of natural wetlands embedded within landscapes dominated by agricultural and residential development. With the exception of STAs, none of these areas are managed with consideration for Snail Kites, nor has their use been considered when assessing landscape-scale availability of prey. Furthermore, financial and logistic limitations preclude inclusion of these foraging habitats in the challenging and expensive monitoring effort devoted to this species. The relative quality of potential Snail Kite foraging sites in Florida, reflected in snail density and availability, shifts unpredictably over time due to, e.g., varying human demands for water, management of aquatic vegetation, and the spatially variable effects of rainfall and droughts. Snail Kite conservation will require habitat management that maintains an overall network in which, at any given time, site-specific snail densities and foraging conditions may vary substantially without jeopardizing kite population growth.

Contact Information: Ken Meyer, Avian Research and Conservation Institute, 411 N.E. 7 Street, Gainesville, FL 32601 USA, Phone: 352-514-5606, Email: meyer@arcinst.org

"AGRI-DOGS": USING CANINES FOR EARLIER DETECTION OF LAUREL WILT DISEASE AFFECTING AVOCADO TREES (*PERSEA AMERICANA*) IN SOUTH FLORIDA

DeEtta Mills[1,2,3,4], *Julian Mendel*[1,2,4], *Christina Burns*[1,2,4], *Beatrice Kallifatidis*[1,2,4], *Kenneth Furton*[1,3,4]

[1]Florida International University
[2]Department of Biological Sciences
[3]Department of Chemistry and Biochemistry
[4]International Forensic Research Institute

A "stowaway" on untreated wooden packaging material, *Xyleborus glabratus*, an invasive ambrosia beetle, along with its fungal partner, *Raffaelea lauricola*, have killed millions of trees in the *Lauraceae* family since 2002. *R. lauricola* colonizes and grows in the tree's xylem, which leads to the complete occlusion of the water transport system due to the systemic immune response from the host tree and the inevitable death of the host. In Florida the disease found not only in the wild laurel forests but also in a new host, the avocado—the economically important and second largest fruit crop in Florida. The disease spreads rapidly and within 4-6 weeks a previously healthy tree can be completely dead. In addition to beetle transport, the fungus can spread between trees through root transmission. Detection of the disease is very difficult as the symptoms appear in the upper crown/leaves first and as a result, it is likely that at the time of detection, surrounding trees have been infected through root transmission or beetle attack. This study reports on the use of scent discriminating canines, trained on the odor of laurel wilt infected avocado wood, and their effectiveness for the earlier detection and rapid management of this disease. Through early pre-symptomatic detection more viable treatment options with the potential of saving trees has been proven to be possible. The results of this study demonstrated the success of this approach with 165 trees detected at the pre-symptomatic stage, of which 155 were treated with propiconazole (Tilt®) and have remained healthy for over a year. Of the 10 untreated trees, 7 succumbed to wilt. In addition, it was determined that canines can detect trees as early as 4-6 weeks before visible symptoms appeared. An economical analysis also demonstrated that using the canines proactively can potentially lead to successful disease management while saving grove owners long term losses that could add up to $2352 per tree detected.

BIO: Dr. Mills is an Associate Professor in the Department of Biological Sciences at Florida International University with experience in molecular microbial ecology and forensic biology. Dr. Mills was the PI on the funded FDACS Specialty Crop Block grant, Disease, Dogs and Drones: Early detection of the laurel wilt pathogen.

Contact Information: Dr. DeEtta Mills, Florida International University, Department of Biological Sciences, OE 167, 11200 SW 8th Street, Miami, FL 33199 USA, Phone: 305 348 7410, Email: millsd@fiu.edu

STEP TWO: DETERMINING THE FEASIBILITY OF BIOLOGICAL CONTROL OF A WEED TARGET

Carey R. Minteer[1], *Greg Wheeler*[2] *and Paul Madeira*[2]
[1]University of Florida, Fort Pierce, FL, USA
[2]USDA-ARS Invasive Plant Research Laboratory, Fort Lauderdale, FL USA

Biological control is a safe, effective and common method of controlling invasive weeds of wetlands and other natural areas. Successful biological control projects often have a very high benefit cost ratio, but the costs are high at the onset of the program and the process of investigating the safety of a potential agent can be lengthy. An often protracted, scientific and regulatory review process then occurs before candidate biological control agents can be released.

To increase safety, efficacy, and transparency of the process, we advocate that, prior to establishing a project, a feasibility study be conducted on a potential weed target to determine whether the project is appropriate. The importance of feasibility studies to the practice of classical biological control of weeds will be discussed along with the process of conducting a feasibility study using examples from current and past feasibility studies on earleaf acacia (*Acacia auriculiformis* Cunn. ex Benth.), air potato (*Dioscorea bulbifera* L.), and Chinese tallowtree (*Triadica sebifera* L.).

BIO: Dr. Minteer is an assistant professor at the University of Florida's Biological Control Research and Containment Laboratory. Carey has worked in the field of biological control for the last 8 years. Her work for the last 3 years has focused on controlling invasive plant species in the greater Everglades ecosystem.

Contact Information: Carey Minteer, UF/IFAS, 2199 S. Rock Road, Fort Pierce, FL Phone: 772-577-7379, Email: c.minteerkillian@ufl.edu

EFFECTIVENESS OF SURVEYING FOR EASTERN INDIGO SNAKES USING ARTIFICIAL COVERS

Steve Mortellaro *and Lindsay Nester*
U.S. Fish and Wildlife Service, Vero Beach, FL USA

A goal of Comprehensive Everglades Restoration Plan (CERP) is to improve water quality and hydrology of the Everglades through the construction of large water treatment projects. During the construction of these projects there is potential to impact federally threatened and endangered species. One of the species that has been impacted by the construction of CERP projects is the threatened eastern indigo snake, *Drymarchon couperi*. The indigo snake is a habitat generalist and is very difficult to find using ocular walking surveys or various trapping methods. Therefore, the U.S. Fish and Wildlife Service (Service) convened an interagency team in 2009 to identify management needs for the federally threatened eastern indigo snake in south Florida. As part of this initiative, the Service, Florida Fish and Wildlife Conservation Commission, Corps and South Florida Water Management District began a study to test field-monitoring techniques for use in determining indigo snake presence. This study was conducted in Martin County, Florida, within the area proposed to be developed as the C-44 Reservoir and Stormwater Treatment Area, a CERP project. The objective of the study was to develop and test survey methods with the potential to document indigo snakes, thereby significantly reducing the cost of locating the species. Artificial cover was placed on the site along a 1.6 km grid on the existing perimeter and interior canals of the 3.2 km by 4.8 km reservoir. A total of 19 stations were established within the footprint of the reservoir. There were 9 different types of artificial cover created: carpet, untreated sheathing plywood, single plywood, 4 stack plywood, single tin, 4 stack tin, 2 stack tin, artificial burrows, and abandoned buildings. The abandoned buildings had the greatest success at attracting indigo snakes. Tin (2 stacks) and plywood (4 stacks) also had some measurable success at attracting indigos. The 4 stacks of plywood had the best success at attracting all other herpetofauna. The stack of 2 tin sheets and a single plywood sheet had the most success at attracting small mammal species. For future cover studies, we recommend an assortment of cover items including plywood (4 stacks), tin (2 stacks), and single plywood. There is no evidence to support the continued use of carpet, untreated sheathing plywood, single tin, or tin (4 stacks) in cover studies.

BIO: Mr. Mortellaro is a Fish and Wildlife Service Biologist with more than 30 years of experience in wetland ecology. For the past 14 years he has been working on a multi-agency team in planning and implementing Everglades restoration projects; including the protection of threatened and endangered species.

Contact Information: Steve Mortellaro, U.S. Fish and Wildlife Service, 1339 20th Street, Vero Beach, FL 32960, Phone: 772- 562-4322, Email: Steve_Mortellaro@fws.gov

MULTI-VEGETATION FEEDBACKS AFFECTING FLOW ROUTING AND BED SHEAR STRESS DISTRIBUTIONS IN EVERGLADES RIDGES AND SLOUGHS

***William Nardin*[1,2,3,4]*, Laurel Larsen*[1]*, Sergio Fagherazzi*[3] *and Patricia Wiberg*[4]

[1]Department of Geography, University of California - Berkeley, Berkeley, CA USA
[2]Center for Environmental Science, University of Maryland, Horn Point Laboratory, Cambridge, MD USA
[3]Department of Earth Sciences, Boston University, Boston, MA USA
[4]Department of Environmental Sciences, University of Virginia, Charlottesville, VA USA

During recent decades coastal wetlands have experienced unprecedented morphological modifications caused by reduction of water fluxes and sediment supply, subsidence, sea level rise, and extreme events. Most previous modeling studies on flow-vegetation-sediment interactions have focused on one specific vegetated community, but we lack a general understanding of the conditions that lead to the emergence of multiple vegetation species feedbacks. Using a modeling approach, this study generates new understanding of how sediment transport and ecogeomorphic interactions involving water flow, sediment, and multiple species of vegetation influence the hydrodynamic and morphodynamic processes in the Everglades ridge and slough landscape. Diverse studies suggest that the abundance of spikerush (*Eleocharis spp.)* in Everglades sloughs has increased in recent decades. Here we evaluate the sensitivity of the processes sculpting the ridge-slough landscape structure to small changes in the abundance and distribution of multiple morphotypes of slough vegetation.

We apply numerical modeling (Delft-3D) and subsequent analyses to test hypotheses about how vegetation characteristics on ridge and slough affect shear stress and sediment distribution. Delft3D is a state-of-the-art hydrodynamic model that provides fine-scale (5 x 5m) computations of depth-averaged flow velocity and bed shear stress, which can be linked to sediment deposition and erosion. Vegetation is modeled using the equations of Baptist (2005), which parameterize hydraulic roughness through the vegetation height, stem density, diameter, and drag coefficient. Here we use values obtained from previous studies for spikerush and sawgrass (*Cladium jamaicense*). Our model domain is a single ridge and slough, 500 m long by 120 – 400 m wide. We evaluate the spatial distribution of bed shear stresses and sediment erosion and deposition for 4 different vegetation scenarios: 1) test case with no-vegetation; 2) vegetation on ridges; 3) vegetation in sloughs and on ridges; 4) vegetation on ridges and multiple vegetative species in sloughs. Model scenarios vary the: vegetation height (from 20 to 100cm), density (from 1 to 10m^{-1}), ridge height (10, 20, 40 and 70cm), representative of historic and current (preserved and degraded) conditions.

Preliminary numerical results show that dense sawgrass on ridges substantially funnels water into sloughs and promotes deposition of sediment at ridge margins. As expected, vegetation within the sloughs decreases velocity and shear stress monotonically with increasing vegetation density. One surprising phenomenon was the emergence of a threshold vegetation density beyond which further increases in vegetation density produce higher velocity in the sloughs with emergent vegetation but lower velocity in sloughs with totally or partially submerged vegetation.

Results are relevant to the conversation about the extent to which spikerush densities in sloughs may need to be reduced in the implement of decompartmentalization. The flipping point behavior suggests that there may be a threshold density of vegetation within sloughs, above which ecogeomorphic feedbacks inevitably lead to further degradation of sloughs.

BIO: Dr. Nardin is an Assistant Professor with a balanced method in a wide range of scientific fields from Hydraulic Engineering to Eco-geomorphology. Dr. Nardin primary research goals are directed toward understanding the geomorphological evolution and restoration strategies of wetlands such as Everglades.

Contact Information: William Nardin, UC Berkeley, McCone Hall, Haviland Path, Berkeley, CA, USA 94720, Phone: 650-772-2184, Email: williamnardin@berkeley.edu

ASSESSING HABITAT USE IN THE AMERICAN CROCODILE (CROCODYLUS ACUTUS), A THREATENED SPECIES IN THE GREATER EVERGLADES ECOSYSTEM

***Jennifer H. Nestler**, Edward F. Metzger III, Brian J. Smith and Frank J. Mazzotti*
University of Florida Ft. Lauderdale Research and Education Center, Ft. Lauderdale, FL, USA

The American Crocodile (*Crocodylus acutus*) is a federally threatened species found primarily in coastal estuarine habitat in southern Florida, the Florida Keys, and throughout Florida Bay. Due to habitat loss, the species was federally listed as endangered by the U.S. Fish and Wildlife Service in 1975. In 2007, the species was upgraded to threatened after intensive habitat protection resulted in an increase in successful nesting. Recent increased sightings of crocodiles at the Naval Air Station Key West (NASKW) led us to survey the base and surrounding areas from 2013-2016. We conducted spotlight surveys in most accessible waterways in the area and recorded GPS locations for crocodiles.

We performed a habitat suitability analysis to assess the population size and habitat use by crocodiles in the Lower Keys. We fit Generalized Linear Models (GLM) using different habitat classes. We included 34 geographic point locations of crocodiles. Habitat suitability was determined by calculating the Euclidean distance to habitat classes at a resolution of $10m^2$. The distance values for each habitat type were extracted for the crocodile observations and 100 randomly generated background points. GLMs were fit for each habitat layer and a null model, and were compared using the differences in Akaike information criterion scores adjusted for sample size (ΔAICc). The top-ranked individual habitat distance layers were combined into several different two-, three-, and four-variable models, which were then compared. The top model was determined by the lowest AIC score. Finally, a predictive GLM was used to assess the relative probability of *C. acutus* occurrence for each variable while holding other variables in the model to a constant distance of 500 m.

The analysis found that distance to estuaries, artificial lacustrine habitat such as impoundments, and artificial waterways such as marinas are the best individual predictors of *C. acutus* presence. Estuaries are the single best individual predictor of crocodile presence. However, the addition of other habitat types, for example artificial lacustrine habitat and salt marshes, improves the fit of the model, indicating that a combination of different habitat types is important. The abundance of mangroves in the area likely leads to them being underrepresented in importance in the models. The predictive GLM indicates that crocodiles are more likely to be present closer to estuaries and artificial impoundments, and their probability of presence decreases in closer proximity to artificial waterways such as boat slips and marinas. The result is most dramatic with estuaries, where the relative probability of presence is highest when closer to estuaries and drops rapidly as distance increases.

These results indicate that a variation in habitat types is important to sustaining the *C. acutus* population, including estuaries, salt marshes, and lacustrine habitat. It also indicates that artificial waterways such as marinas with steep concrete seawall are selectively avoided by crocodiles.

BIO: Jennifer H. Nestler is a wildlife biologist and data manager with the Croc Docs in the Department of Wildlife Ecology and Conservation at the University of Florida.

Contact Information: Jennifer H. Nestler, University of Florida Department of Wildlife Ecology and Conservation, 3205 College Ave., Fort Lauderdale, FL, USA 33314, Phone: 954-577-6304, Email: jnestler@ufl.edu

VARIATION IN BODY CONDITION OF ALLIGATOR MISSISSIPPIENSIS IN FLORIDA

Laura A. Brandt[1], ***Jennifer H. Nestler***[2], *Arnold M. Brunell*[3], *Jeffrey S. Beauchamp*[2], *And Frank J. Mazzotti*[2]
[1]U.S. Fish and Wildlife Service, Davie, FL, USA
[2]Universtiy of Florida, Davie, FL USA
[3]Florida Fish and Wildlife Conservation Commission, Eustis, FL USA

We examined body condition (using Fulton's K with snout-vent length and weight) for 482 American alligators (*Alligator mississippiensis*) collected from 14 aquatic sites in Florida in 2011 and 2012. An information-theoretic approach using Akaike information criterion (AIC) was used to select the best models for alligator body condition from a suite of seven candidate models created using combinations of trophic state (oligotrophic, eutrophic, hypereutrophic), sex, and alligators/km. Our top model included trophic state and alligators/km indicating that alligator body condition from sites classified as hypereutrophic and eutrophic (2.43 ± 0.07 and 2.45 ± 0.05, respectively) were greater than alligator body condition at oligotrophic sites (2.14 ± 0.01). Alligator body condition was lower at sites with a higher density of alligators ≥ 1.25 m. Across all sites, average alligator body condition ranged from 1.94 ± 0.054 (SE) to 2.78 ± 0.121(SE). This was a 43% difference in alligator body condition between the site with the highest alligator body condition (Lochloosa Lake, a hypereutrophic lake in north-central Florida) compared to the site with lowest body condition (Water Conservation Area 3B, an oligotrophic marsh in the Everglades). Across all sites, average alligator body condition was 12% greater at eutrophic and hypereutrophic sites compared to oligotrophic sites which was consistent with patterns observed in other studies for fish standing stock (highest in eutrophic lakes and lowest in oligotrophic marshes in the Everglades). The same patterns occur in alligator stomach content volume (higher in lakes in north-central Florida, Louisiana fresh, intermediate, and brackish marshes compared to the Everglades). Our results illustrate that variation in alligator body condition is consistent with patterns of aquatic site productivity and is a useful parameter for describing differences in aquatic site ecological condition.

<u>BIO</u>: Dr. Brandt is a wildlife biologist with more than 20 years of experience working in the Everglades on crocodilian ecology, landscape ecology, and linking science and management.

<u>Contact Information</u>: Laura A. Brandt, U.S. Fish and Wildlife Service, 3205 College Ave, Davie, FL, USA 33314. Phone: 954-577-6343, Email: laura_brandt@fws.gov

EFFECTS OF INCREASED FLOW AND ASSOCIATED PHOSPHORUS LOADS ON MICROBIAL RESPONSES

***Sue Newman**[1], Erik Tate-Boldt[1], Barry Rosen[2], Alan Wright[3], Colin Saunders[1], Chris Hansen[1,4] and Michael Manna[1]*
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]US Geological Survey, Orlando, FL, USA
[3]University of Florida, Ft. Pierce, FL, USA
[4]Florida International University, Miami, FL, USA

Restoration of flow is a key objective of the Comprehensive Everglades Restoration Program (CERP). With increased flow, phosphorus (P) loads will also increase. We hypothesized that because the native periphyton community is P-limited, increased loads will increase biomass and productivity; and if the threshold P load is exceeded, the periphyton community will be altered, with the loss of the most P sensitive species, and the stimulation of species that require higher phosphorus thresholds. We tested this hypothesis by deploying periphytometers and multi-parameter sensors along a flow gradient, ranging from 250 to 800 m from inflows within the Decompartmentalization Physical Model (DPM). Preliminary results indicated diatoms were the dominant community across all sites, comprising > 70 % of organisms found. The greatest abundances of Cyanobacteria were observed at the most distant sites, while green algae were most abundant at the site closest to inflow. In general, microbial biomass accumulation on the periphytometers was greatest at sites closest to inflow, and attenuated under reduced or non-flowing conditions. Similarly, these sites generally had higher P concentrations (700-1100 mg/kg) during flowing conditions than the most distant site (400-500 mg/kg). To link periphyton species and biogeochemical cycling, the activity of phosphatase enzymes, an indication of P limitation, was also assayed. Sites with elevated periphyton P concentrations were associated with decreased phosphatase activity, demonstrating the reduction in P limitation of the periphyton community. In addition to flow, seasonal light and temperature changes had a significant effect on periphyton species and biomass, and influenced primary production. Though preliminary, the results suggest that even under low surface water TP concentrations, P loading at elevated velocities may be important in governing periphyton community type, biomass, and the production and cycling of organic matter and P.

<u>BIO</u>: Dr. Newman is a Senior Scientist and Section Leader of the Marsh Ecology Research Group, with over 25 years of experience conducting research and restoration projects in the Everglades.

<u>Contact Information</u>: Sue Newman, Everglades Systems Assessment Section, South Florida Water Management District, 8894 Belvedere Road, West Palm Beach, FL, USA 33411, Phone:561-753-2400 ext. 4626, Email:snewman@sfwmd.gov

HOW A DISTURBANCE EVENT IMPACTED THE OVERWINTERING HOME RANGE OF COMMON SNOOK

Jessica Noble[1], *Joy Young*[2], *Lauren Kircher*[1], *Matia Gringas*[1], *Lissette Geubelle*[1], *and John Baldwin*[1]
[1]Florida Atlantic University, Boca Raton, FL, USA
[2]Florida Wildlife Research Institute, Tequesta, FL, USA

Disturbance events (ex: wildfires, extreme temperature shifts, disease) are occurrences that have increased magnitude, duration, and/or frequency compared to disturbances within the normal disturbance regime. The effects of disturbance events can include changes in behavior, like altering home range. Home range is the space most utilized in an area by an individual; it can include their movements year round or be limited to season. Previous studies have described spawning sites of common snook (*Centropomus undecimalis*), however overwintering home range within the Indian River Lagoon is still unknown. With the use of acoustic telemetry data this project will identify overwintering home ranges of common snook and describe the changes in their overwintering home range size during the 2010 extreme cold event. It will be focused on the time period of the event (Jan 2-13) between years 2009-2012. The goal is to understand fine scale movements under normal and disturbance event conditions.

BIO: Jessica Noble is a graduate student at Florida Atlantic University, pursuing her Master's degree in Marine Ecology. Her current research looks into the effects of a disturbance event on fine scale movement and population dynamics of an estuarine sportfish.

Contact Information: Jessica Noble, Florida Atlantic University, 3200 College Ave, Davie, FL, USA, 33314, Phone: 561-252-5694, Email: Jnoble9@fau.edu

PHYLOGENETIC DISTRIBUTION OF MERCURY METHYLATORS IN THE WATER CONSERVATION AREAS

Hee-Sung Bae[1], ***Andrew Ogram[1]***, *and F. E. Dierberg[2]*
[1]University of Florida, Gainesville, FL USA
[2]DB Environmental, Rockledge, FL USA

An understanding of the rates and processes that drive the methylation of Hg(II) to form methyl mercury are critical to predicting the bioaccumulation of methyl mercury through the Everglades food chain. The importance of sulfate reducing bacteria (SRB) as the dominant mercury methylators in many ecosystems has been well known since the 1970's; however, mercury methylation has been reported in non-sulfidogenic environments, indicating that sulfate reduction is not the only process involved in mercury methylation. The recent discovery of the genes (*hgcAB*) that control mercury methylation by prokaryotes has provided great insight into the diversity of metabolisms that are capable of mercury methylation, including the potential diversity of metabolisms in the Everglades. We have investigated the numbers and phylogenetic distribution of *hgcA* sequences in various environmental compartments in WCA-2A and 3A that include a range of sulfate concentrations.

As a group, SRB exhibit diverse metabolisms due to the broad phylogenetic distribution of the use of sulfate as a terminal electron acceptor. The dominant *hgcA* sequences in WCA-2A are associated with the syntrophic branch of the detlaproteobacteria, or SRB that are capable of switching to a fermentative metabolism in low sulfate concentrations, and are very important in carbon cycling in methanogenic systems such as the Everglades. It is not know at this time if SRB in the Everglades actively methylate mercury syntrophically; however, this group of SRB actively transcribes genes in WCA-2A, indicating their general activity either via sulfate reduction or syntrophy.

In the low sulfate concentration areas of WCA-3A, a shift away from the deltaproteobacteria and toward other groups such as the methanogens and firmicutes is observed, particularly in the detritus and periphyton, where *hgcA* sequences cluster with methanogens and firmicutes.

These results indicate that different metabolic processes may be involved in mercury methylation in different areas of the Everglades; however, the relative activities of these processes requires further investigation.

<ins>BIO</ins>: Dr. Ogram is a microbial ecologist with approximately 20 years of experience studying microbial ecology of carbon and nitrogen cycling in anoxic soils, and has been interested in the complexity of processes responsible for mercury methylation in the Everglades for several years.

<ins>Contact Information</ins>: Andrew Ogram, Soil and Water Sciences Department, PO Box 110290, University of Florida, Gainesville, FL 32611, Phone: 352-294-3138, Email: aogram@ufl.edu

STABILIZATION OF EVERGLADES' CULTURAL RESOURCE SITES WITH INTEGRATED ECOSYSTEM RESTORATION

Danielle E. Ogurcak[1]*, Randall W. Parkinson*[1]*, Todd A. Crowl*[1,2] *and Margo Schwadron*[3]

[1] Florida International University, Institute of Water and Environment, Miami, FL, USA
[2] Florida International University, Sea Level Solutions Center, Miami, FL, USA
[3] National Park Service, Southeast Archeological Center, Tallahassee FL, USA

Cultural resource sites are found throughout the greater Everglades' ecosystem in a variety of environmental settings. These sites date to both colonial and pre-colonial times, and examples include burial mounds, ancient engineering, and shell middens. Most sites are found in close proximity to the coastline or embedded in surrounding wetlands. As a consequence, these sites are vulnerable to the effects of accelerating sea level rise and anthropogenic climate change that will bring higher tides, more frequent strong hurricanes, and increased erosion. As each site is found in a specific geomorphologic setting, the threats to sites vary spatially. Prioritizing stabilization requires identification of the unique settings in which each site is found, an assessment of current and future threats, and a determination of possible management interventions.

We have completed phase I of the project; initial assessment of eroding shell middens within the Ten Thousand Islands region. Many of these locations have experienced several meters of horizontal erosion within the past several decades, leading to loss of cultural materials through toe scour and associated mass wasting (collapse) of high-grounds. We are in the process of determining strategies for stabilization, prioritizing actions, and will soon begin testing stabilization techniques with subsequent monitoring to quantify success of the interventions. Communication of progress and inclusion of community stakeholders will provide opportunities for citizen science and outreach. Integrated ecosystem restoration has a significant role to play in adaptation strategies as sea level rises and hydrologic regimes are modified under Everglades restoration.

BIO: Dr. Ogurcak is a postdoctoral associate with a degree in Earth Systems Science from Florida International University. She has over 10 years of experience in ecological research in the Everglades and the Florida Keys.

Contact Information: Danielle E. Ogurcak, Institute of Water and Environment, Florida International University, 11200 S.W. 8th Street, Miami, FL, 33199, Phone: 305-348-3095; Fax: 305-348-4096; Email: dogur001@fiu.edu

ECOSYSTEM-WIDE MODELING OF METHYLMERCURY DISTRIBUTIONS IN THE EVERGLADES: RESPONSES TO REDUCTIONS IN SULFATE LOADING

William Orem[1], *Carl Fitz*[2], *David Krabbenhoft*[3], *and George Aiken* [4]

[1]U.S. Geological Survey, Reston, VA, USA
[2]EcoLandMod, Inc., Fort Pierce, FL, USA
[3]U.S. Geological Survey, Middleton, WI, USA
[4]U.S. Geological Survey, Boulder, CO, USA

Mercury (Hg) contamination of the Everglades remains a significant issue, inextricably connected with water and land use, and the restoration program. The conversion of Hg to methylmercury (MeHg), the most toxic and bioaccumulative form of Hg, is a key process at the center of this problem. MeHg production in the Everglades is dominantly facilitated by microbial sulfate reduction. The ecosystem receives significant sulfate loading driving this microbial process, and some of the highest levels of atmospheric Hg deposition in the US driving production of MeHg. Other natural conditions in the Everglades also promote MeHg production (e.g. circumneutral pH, high levels of dissolved organic matter, and anaerobic peat substrate). Mitigation of contaminant issues and the associated beneficial use impairments, including MeHg, is a major goal of Everglades restoration. Atmospheric Hg deposited to the Everglades appears to be largely from distant sources, and efforts to reduce local Hg loading would appear to have limited mitigation potential. Other approaches for reducing MeHg production, such as reducing dissolved organic matter content or changing the ecosystem pH are untenable.

We have proposed a strategy for mitigation of MeHg contamination in the Everglades by reducing sulfate loading. Canal water discharged to the Everglades contains unnaturally high levels of sulfate originating from land use and agricultural practices in the Everglades Agricultural Area. A conceptual model of the complex biogeochemistry relating sulfate loading and MeHg production has been developed that successfully explains observed spatial and temporal distributions of MeHg. From this conceptual model, a mathematical model based on a modified version of the Everglades Landscape Model that incorporates sulfate and MeHg production modules was developed. The model was used to evaluate how changes in sulfate loading impacts sulfate distributions and resulting risk from MeHg production. Output from the model includes maps of sulfate concentration and MeHg production risk. The model was previously used to evaluate increases in sulfate loading from aquifer storage and recovery, and recently used to address specific questions regarding how reductions in sulfate loading (e.g., 94%, 37%, and 25% reductions) might reduce MeHg production risk in the Everglades. Results show that reductions in sulfate loading as low as 25% can mitigate the MeHg production risk over large areas of the Everglades. The model is a useful tool to assist land/water managers in visualizing where reductions in MeHg risk occur, should reductions in sulfate loading be implemented as a mitigation strategy for mercury in the Everglades.

BIO: Dr. Orem is a Supervisory Research Chemist with the U.S. Geological Survey in Reston, VA with over 20 years of experience working on Everglades contaminant issues. He has more than 150 peer reviewed publications on topics such as contaminants, biogeochemistry, energy resources, marine geochemistry, and human health.

Contact Information: William Orem, U.S. Geological Survey, 956 National Center, Reston, VA 20192; Phone: (703) 648-6273; Email: borem@usgs.gov

ARE BURMESE PYTHONS ATTRACTED TO TREE ISLANDS WITH WADING BIRD COLONIES? USING EDNA TO DETERMINE OCCUPANCY RATES OF PYTHONS AT WADING BIRD BREEDING SITES IN THE EVERGLADES

***Sophia C. Orzechowski*[1]**, *Margaret Hunter*[2], *and Peter Frederick*[1]
[1]University of Florida, Gainesville, FL, USA
[2]US Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

Burmese pythons (*Python molurus bivittatus*) may pose a predation threat to nesting long-legged wading birds in the Everglades but detection and ensuing conservation and management efforts are hampered by the extreme crypticity of this exotic apex predator. Small mammals have hitherto constituted 75% of python diets, but now that mammals have declined by 95% due to pythons, we predict a shift in diet towards birds. Wading bird nesting colonies, which range from dozens to thousands of breeding pairs, represent an energetically dense, attractive food source. Pythons may impact colonies by preying upon adults, juveniles, and eggs, as well as potentially causing abandonment of breeding pairs or colony failure. We are testing a new method of harnessing the directionality of flowing water in the Everglades to more efficiently detect Burmese pythons using environmental DNA (eDNA). Environmental DNA originates from cellular material shed by snakes into water, via their skin and excrement, and can be used for species identification. Sampling aquatic eDNA has been an effective way to detect Burmese pythons throughout south Florida and along their northern range limit. Compared to detection rates using traditional survey methods (<1%), detection rates using eDNA are vastly improved (91-100%). In a 2016 pilot study, we sampled eDNA from 12 tree islands within Water Conservation Area 3A, north of Everglades National Park. Seven islands contained active wading bird colonies and five islands were controls, comparable in size and vegetation type. We sampled both downstream and upstream of all islands to account for snake DNA originating upstream of the focal island, and we only sampled sites with neighboring islands more than a mile upstream. Using a hierarchical occupancy model, we will estimate python detection and occupancy rates at each island to compare differences between islands with wading birds versus empty islands. Once we determine the efficacy of our methods with the pilot study results, we will implement a larger study in 2017. This work fulfills a need for a clear assessment of the potential impact of this invasive snake on wading bird reproduction and survival.

BIO: Sophia Orzechowski is a graduate student at the University of Florida, advised by Dr. Peter Frederick. For her Master's she is quantifying the potential impacts of invasive Burmese pythons on wading bird reproduction in the Everglades.

Contact Information: Sophia C. Orzechowski, MS student, Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA 32611, Phone: 603-398-8838, Email: sorzechowski@ufl.edu

SPATIAL DISTRIBUTIONS OF SOIL BIOGEOCHEMICAL PROPERTIES IN STORMWATER TREATMENT AREA 3/4 CELLS 3A AND 3B

Todd Z. Osborne[1,2], *Rupesh Bhomia*[2], *Paul Julian*[3] *and K. Ramesh Reddy*[1]
[1] Whitney Laboratory for Marine Bioscience, University of Florida, St. Augustine, FL, USA
[1] Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA
[3] Soil and Water Sciences Department, University of Florida, Ft. Pierce, FL, USA

Investigation of spatial distributions of edaphic properties has been utilized successfully to assess ecosystem condition throughout the Everglades. We utilize spatial analyses to identify processes and trends in soil components (litter, floc, recently accreted soil (RAS) and pre-STA soils) of Cells 3A and 3B of STA-3/4. Cell 3A being in the front end of treatment flow path, received inflow waters with relatively higher P concentration than Cell 3B which received treated water with lower TP concentration. Cell 3A is dominated by emergent aquatic vegetation (EAV) while Cell 3B is dominated by submerged aquatic vegetation (SAV). We were able to assess the effects of variable P loading rates (1.32 +/- 0.18 g P $m^{-2}yr^{-1}$in 3A; 0.83 +/- 0.14 g P $m^{-2}yr^{-1}$in 3B) and dissimilar vegetation communities on soil processes in these treatment cells.

Spatial mapping was conducted on data from a spatial sampling effort (Cell 3A-65 soil cores; Cell 3b 56 cores) conducted in fall of 2015. The geostatistical wizard extension of Arc GIS V. 10.4 was used to create Kriging models and DOT maps (for trend validation) of total carbon (TC), total nitrogen (TN), total phosphorus (TP), total sulfur (TS) and total calcium (TCa). Phosphorus storage was calculated utilizing P concentration, bulk density, and depth for each soil component.

Floc TP exhibited trends of highest enrichment proximal to inflows in Cell 3A with concentrations diminishing towards the south (outflows) in Cell 3B. Spatial patterns of enrichment of floc in Cell 3A were substantially higher than Cell 3B. Trends in floc TP in southern portion of Cell 3A and northern portion of Cell 3B suggest an established breakpoint in floc concentration at the change point in vegetation. Trends in RAS TP were very similar to those of floc in Cell 3A and 3B exhibited steady declines in TP from inflows to the outflows. Likewise, spatial trends suggest a break point at the levee between 3A and 3B which also demarcates the change in vegetation from EAV to SAV dominance. Although TP trends in floc and RAS were similar, the RAS TP concentration as a whole was lower than the floc component directly above it in the soil profile. Pre-STA soils were found to be much more homogenous with spatial trends suggesting enrichment of this soil profile with P from inflows. Overall, TP model trends suggest strong gradients from inflows to outflows in litter, floc, RAS and pre-STA soils and a strong break point at the back end of Cell 3A and front end of Cell 3B. Phosphorus storages were typically higher in Cell 3A in comparison to SAV cell (Cell 3B). This was in contrast to STA-2 Cell 3 and Cell 1, where SAV cells had higher TP storages. Concentrations of TP, TC, TN and TS were lower in all soil sections in SAV (Cell 3B) but TCa concentration were higher. Mass storages of macronutrients and TCa were higher in floc layer of STA-3/4 Cell 3B, but for RAS and pre-STA soil layer, TP, TC, TN, TS and TCa storages were higher in EAV Cell 3A suggesting differences in the influence of vegetation type across soil components.

BIO: Dr. Osborne is an Assistant Professor of Soil and Water Science with 18 years of experience in the Everglades Restoration arena. He has extensive experience with wetland soil biogeochemistry and has led or participated in more than 20 funded projects concerning Everglades soil processes, plant ecology and water quality

Contact Information: Todd Z. Osborne, Estuarine Biogeochemistry Laboratory, Whitney Laboratory for Marine Bioscience, 9505 Ocean Shore Blvd. St. Augustine, FL 32080, Phone (904) 461-4047, Email osbornet@ufl.edu

COASTAL WETLAND VULNERABILITY TO SEA-LEVEL RISE IN THE GREATER EVERGLADES: A SYNTHESIS OF USGS WETLAND SURFACE ELEVATION CHANGE STUDIES

Michael J. Osland[1], *Laura C. Feher*[1], *Gordon H. Anderson*[2], *Ken W. Krauss*[1]
[1]U.S. Geological Survey, Lafayette, LA, USA
[2]U.S. Geological Survey, Gainesville, FL, USA

By the end of the 21st century, sea-level rise is expected to have a tremendous impact on wetland ecosystems in the Greater Everglades. Wetlands in the region provide many important ecosystem goods and services. In addition to supporting fish and wildlife habitat, these ecosystems protect coastlines, store carbon, improve water quality, modulate hydrologic regimes, and provide recreational opportunities. Resource managers are increasingly challenged to develop future-focused management strategies that will help ensure that these ecosystem goods and services are available for future generations. However, best management practices depend upon knowledge and data regarding the processes that govern ecosystem responses to sea-level rise.

Coastal wetland responses to sea-level rise are greatly influenced by ecogeomorphic processes that affect wetland surface elevation. Small changes in elevation relative to sea level can lead to comparatively large changes in ecosystem structure and function and, in the most extreme cases, wetland loss via conversion to open water. The surface elevation table-marker horizon approach (SET-MH) is a method for quantifying the relative contributions of processes that affect net wetland surface elevation change (for example, accretion, subsidence, root zone expansion). Since the late 1990s, scientists at the U.S. Geological Survey have been measuring surface elevation change in Greater Everglades coastal wetlands using a combination of surface elevation tables, marker horizons, and hydrologic stations. These stations have been installed at nine study sites located along the Shark River, Big Sable Creek, and Lostmans River. The data from these sites have been used for many different purposes including investigation of: (1) the effects of hydrologic fluctuations on mangrove forest peat expansion and contraction; (2) the elevation change implications of hurricane-induced conversion of mangrove forests to mud flats; (3) the ecological effects of hurricane-induced sediment deposition on mangrove forests; and (4) the implications of elevation change variation across salinity gradients. In this presentation, we synthesize data from all of these study sites and discuss the implications of our results for future coastal wetland responses to sea-level rise.

BIO: Dr. Osland is a Research Ecologist at the U.S. Geological Survey's Wetland and Aquatic Research Center. In broad terms, his research examines the response of ecosystem to changing conditions including the implications for conservation and restoration.

Contact Information: Michael Osland, U.S. Geological Survey, 700 Cajundome Blvd., Lafayette, LA, USA 70506, Phone: 337-266-8664, Email: mosland@usgs.gov

MODIFIED WATER DELIVERIES TO EVERGLADES NATIONAL PARK: AN INCREMENTAL APPROACH TO RESTORATION

Gina Paduano Ralph, *Melissa Nasuti, Daniel Crawford, Lan Do, Luis Alejandro, Donna George*
U.S. Army Corps of Engineers, Jacksonville, Florida, USA

The Central and Southern Florida Project (C&SF) was authorized to function as a multi-purpose water management system. The Congressionally-authorized purposes of the C&SF Project include flood control, agricultural irrigation, municipal and industrial water supply, preservation of fish and wildlife, water supply to Everglades National Park (ENP), preservation of ENP, prevention of saltwater intrusion, drainage and water control, groundwater recharge, recreation, and navigation. The C&SF Project was subsequently altered through authorization of two projects designed to improve hydrologic conditions in ENP. The Modified Water Deliveries Project includes modifications to the C&SF Project to provide a system of water deliveries to ENP across the full width of the historic Shark River Slough flow-way. The C-111 South Dade Project was designed to control seepage out of ENP and reduce damaging freshwater discharges to Manatee Bay/Barnes Sound while maintaining flood protection to agricultural lands east of C-111 Canal.

The MWD Increment 1 field test is the first increment in a series of sequential efforts that will result in a comprehensive integrated water control plan, referred to as the Combined Operating Plan (COP), for the operation of the water management infrastructure associated with the MWD and C-111 South Dade Projects. The incremental approach to the development of COP will 1) allow interim benefits towards restoration of the natural systems, 2) reduce uncertainty of operating the components of the MWD and C-111 South Dade Projects, and 3) provide information to complete COP efficiently. The increments include conducting field tests for existing structures, developing operating criteria for existing and planned structures, and ultimately updating water management operations for this area of the C&SF Project.

The U.S. Army Corps of Engineers implemented the MWD Increment 1 Field Test in October 2015. Upon review of monitoring data associated with MWD Increment 1 and the intervening 2016 Temporary Emergency Deviation, it became apparent that additional modifications were necessary to meet the multiple C&SF Project purposes. This poster will present lessons learned through MWD Increment 1 and the intervening 2016 Temporary Emergency Deviation and demonstrate how those lessons learned were used to inform water management operations for this area of the C&SF Project.

BIO: Dr. Ralph is the Chief of the Environmental Branch, Planning Division, U.S. Army Corps of Engineers, Jacksonville, Florida. Dr. Ralph has over 15 years' experience in environmental restoration, including 7 years of Comprehensive Everglades Restoration Plan experience with the U.S. Army Corps of Engineers.

Contact Information: Gina Paduano Ralph, Ph.D., Planning and Policy Division, Environmental Branch, U.S. Army Corps, , 701 San Marco Boulevard, Jacksonville, FL, 32256, USA, Phone: 904-232-2336, Email: Gina. P. Ralph@usace.army.mil

AVIAN SOURCE LOCALIZATION FROM A SMALL-APERTURE ACOUSTIC ARRAY

Joseph Park[1], *Kevin Kotun*[1] *and Tylan Dean*[2]
[1]Everglades National Park, Physical Resources, Homestead, FL, USA
[2]Everglades National Park, Biological Resources, Homestead, FL USA

We demonstrate a small aperture acoustic array providing minimal habitat disruption, maximal logistical and deployment efficiency and excellent source bearing discrimination. Source localization is determined with the Sound Finder algorithm based on time difference of arrival (TDOA) between multiple sensor pairs. We introduce the use of cross-spectral coherence as a requisite for computation of time delays by cross-correlation in order to minimize the likelihood of interference from noise. The compact nature of the array imposes a penalty on source range estimation since there is minimal spatial diversity among sensors. A field test in Everglades National Park assessed array performance finding results consistent with analytical determinations of TDOA solutions suggesting that the lack of sensor spatial diversity is the primary source of localisation error, not sensor position uncertainty or recorded signal timing accuracy.

The Cape Sable seaside sparrow is an endangered species at-risk from habitat reduction. The sparrow habitates open grasslands sustained by a range of wetland hydroperiods and there is concern that environmental change is leading to a reduction in suitable habitat. Observing the sparrow is difficult. The bird is small, its habitat remote and difficult to access, only males sing, and only during the breeding season. These difficulties limit data informing the sparrows range, population, and importantly their response to environmental conditions. For example, it is thought that sparrows avoid habitat with woody vegetation, are behaviorally impacted by inundation, and vocalize primarily in the early morning. We present analysis of a 5 month monitoring effort using passive acoustics to observe sparrow behavior finding that sparrows avoid a treeline while engaged in territory defense, continue to vocalize while habitat is inundated, that specific individuals can be uniquely identified from spectral signatures, and quantify the hourly distribution of song. Creation of suitable habitat through ecological management may be a crucial tactic for the survival of the species, our results indicate that removal of invasive woody vegetation may provide such a transition.

BIO: Dr. Park is a physical scientist with a background in acoustics, oceanography and hydrology. Mr. Kotun is the Chief Hydrologist and Physical Resources Branch Chief at the South Florida Natural Resources Center, Dr. Dean is the Biological Resources Branch Chief at the South Florida Natural Resources Center.

Contact Information: Joseph Park, 950 N Krome Ave Homestead, FL, USA 33030, Phone: 305-224-4250, Email: Joseph_Park@nps.gov

UNDERSTANDING THE REPRODUCTIVE CHEMICAL ECOLOGY OF INVASIVE REPTILES: BURMESE PYTHONS AND ARGENTINE TEGUS

***M. Rockwell Parker*[1]**, *Shannon Richard*[1], *Ricky Flores*[1], *Christina Tyndall*[1], *and Michael L. Avery*[2]
[1]Department of Biology, James Madison University, Harrisonburg, VA USA
[2]National Wildlife Research Center-U.S. Department of Agriculture, Gainesville, FL USA

Reptiles use chemical sexual signals to locate and choose between mates across diverse landscapes, and this is especially true in squamate reptiles (snakes, lizards). To date, all studies investigating reproductive chemical ecology in snakes have shown that males use conspecific scents in mate choice as do males in several families of lizards. From this perspective, we have been studying the potential for field deployment of chemical cues to increase trapping success of invasive reptile species in the Florida Everglades. The majority of our collaborative research has focused on Burmese pythons (*Python bivittatus*), but more recently we started a preliminary project to understand chemical signals in Argentine tegus (*Salvator merianae*). Both species are substantial threats to native fauna in Florida via predation and have potentially high reproductive capacity in their invasive ranges, especially the Burmese python. The sexual chemical cues used by these species to facilitate mate searching are hypothesized to be lipids/lipophilic based on decades of work in reptile chemical ecology. We use a combination of bioassays (male-female courtship assays, Y-maze trials) and analytical chemistry techniques (chromatography, GC-MS) to extract sex-specific skin lipids and create scent trails. To date, we have validated that lipids extracted from shed skins of Burmese pythons elicit predictable, sex-specific behaviors from conspecifics. Identification of individual compounds in both sexes of Burmese pythons is ongoing as is a new approach to understand the seasonal variation in biological richness of python scents. With tegus, we have successfully extracted sufficient lipids from male and female shed skins and are preparing to begin Y-maze trials with those extracts. Collectively, our results suggest that manipulation of chemical communication in at least Burmese pythons has promising utility in future wildlife management strategies for invasive reptiles.

BIO: Dr. Parker is a chemical ecologist and comparative endocrinologist specializing in pheromone extraction, identification, and bioassays in reptiles. He has studied animal behavior for 15 years and has 10 years of experience in analytical chemistry. He is also studying other species of snakes (brown treesnakes, garter snakes).

Contact Information: M. Rockwell Parker, Department of Biology, James Madison University, MSC 7801, Harrisonburg, VA, USA 22807, Phone: 541-740-5070, Email: parke3mr@jmu.edu

DEVELOPMENT OF THE RECOVER FIVE YEAR PLAN

April Nudo Patterson[1]*, Patti Gorman*[2]*, David Rudnick*[3]*, Fred Sklar*[3]*, Agnes McLean*[3]*, Andrew LoSchiavo*[1]*, Joan Browder*[4]*, Eric Hughes*[5]*, Barry Rosen*[6]*, Rebecca Elliott*[7]*, Gretchen Ehlinger*[1]*, Kelly Keefe*[1]*, Steve Traxler*[8]

[1]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL USA
[3]Everglades National Park, Florida City, FL USA
[4]National Oceanic and Atmospheric Association, Miami, FL USA
[5]U.S. Environmental Protection Agency, Jacksonville, FL USA
[6]U.S. Geological Survey, Orlando, FL USA
[7]Florida Department of Agriculture and Consumer Services, West Palm Beach, FL USA
[8]U.S. Fish and Wildlife Service, Vero Beach, FL USA

Given the past ten years of monitoring data, the pace of Comprehensive Everglades Restoration (CERP) implementation, new knowledge gained on major drivers and stressors such as climate change and exotics, and the completion of a programmatic AM plan, the CERP RECOVER Leadership Group requested that a comprehensive review of the RECOVER (Restoration, Coordination, and Verification) science program be developed. Everglades program managers and the Committee on Independent Science Review of Everglades Restoration Progress (CISRERP) also encouraged RECOVER to develop a long-term monitoring strategy. As a result, RECOVER convened an interagency steering committee comprised of eight of the twelve agencies to discuss the current state of everglades science and take a long term look.

While the makeup of the RECOVER team is diverse, the mission and goals of RECOVER are well known to this dedicated group of scientists and science managers. As a result, the team resolved to build consensus on the purpose of the effort. The steering committee took six months to develop six focus areas designed to inform on changes in the environment, physical changes to the system, and measurement of goals and targets for reporting and subsequent adaptive management actions. The team identified the changes that will be studied and incorporated into monitoring, modeling, and other components of the existing science framework for the next decade.

BIO: Ms. Patterson is a CERP project manager. She communicates the status of the restoration efforts and the Everglades restoration science information developed by teams of interdisciplinary scientists and engineers to leadership and interagency decision-making forums. Ms. Patterson managed RECOVER through the development of the CERP Programmatic Adaptive Management Plan and the 2014 System Status Reports. She also managed the CERP ASR Regional Study team.

Contact Information: April Nudo Patterson, U.S. Army Corps of Engineers, Jacksonville District, 701 San Marco Blvd., Jacksonville, FL, USA 32205, Phone: 904-232-2610, Email: April.N.Patterson@usace.army.mil

A COMPARISON OF THE BENEFITS OF NORTHERN AND SOUTHERN EVERGLADES STORAGE

Rajendra Paudel, *Thomas Van Lent*
Everglades Foundation, Palmetto Bay, FL USA

Water storage is critical to meet human and environmental water requirements in South Florida and is a vital component of the Comprehensive Everglades Restoration Plan (CERP). Storage is an essential water management tool in CERP to meet flood control, water supply and environmental demands. The Greater Everglades water storage capacity has been diminished considerably due to drainage and landscape modifications, depriving the southern Everglades of freshwater during dry years and resulting in regulatory discharges to the Northern Estuaries during wet years. Therefore, storage is an important component to replace the lost capacity, reduce harmful discharges and meet increasing demands of water for both people and the ecosystem.

Here, we investigated the hydrologic benefits of storage located north of the Lake Okeechobee (Northern Reservoir) and storage south of the Lake Okeechobee (EAA Reservoir) compared with the current infrastructure and operating rules (Existing Baseline Condition). We used South Florida Water Management Model (SFWMM) hydrologic model to simulate these three scenarios. We assumed that these reservoirs were constructed at present day and made no assumptions about the project other than what is in the official CERP plan. The analysis was intended to explore solely at the relative benefits of these two elements of CERP so that a direct comparison between two options is possible.

Results showed that the EAA Reservoir reduced the volume of harmful discharges from Lake Okeechobee to the Northern Estuaries by nearly 50%, while the Northern Reservoir reduced volume of discharges by about 6%. As EAA Reservoir presented a new outlet southward, it provided the additional benefit of increasing flows in the Everglades by about 26%. The Northern Reservoir provided major benefits to Lake Okeechobee by increasing the water levels during the drought. Operational and structural improvements could be made that could potentially increase benefits, but this direct comparison will give a better idea of the benefits that each of these two storage options produce.

BIO: Dr. Paudel is a hydrologist at the Everglades Foundation. He has over 15 years of experience as a researcher and engineer at universities, non-profit organizations and consulting firms and has worked on several water resources planning and management projects including Everglades restoration projects.

Contact Information: Rajendra Paudel, Everglades Foundation, 18001 Old Cutler Road, Suite 625, Palmetto Bay, FL, USA 33157, Phone: 786-249-4458, Email: rpaudel@evergladesfoundation.org

REVISITING EVERGLADES SPECIES ECOLOGICAL MODELS FOR PLANNING AND ASSESSMENT

Leonard Pearlstine[1], *James Beerens*[2], *Stephanie Romañach*[2], *Dilip Shinde*[1], *Jay Sah*[3], *Mike Ross*[3], *Laura A Brandt*[4], *Amy Nail*[5]

[1]National Park Service, Homestead, FL, USA
[2]U.S. Geological Survey, Davie, FL, USA
[3]Florida International University, Miami, FL, USA
[4]U.S. Fish and Wildlife Service, Davie, FL, USA
[5]Honestat Statistics & Analytics, LLC, Raleigh, NC, USA

The last five years have seen a rapid growth in use and development of ecological models for spatially estimating wildlife habitat and vegetation community changes from Everglades restoration and management. Most prominently, a suite of these ecological models were applied in the Central Everglades Planning Project (CEPP) to assist in scenario selection of a tentative plan for future hydrologic restoration and in South Dade Investigations (SDI) of alternative hydrologic scenarios for water delivery impacts to Everglades National Park (ENP) and adjacent areas. The coming years are promising to more strongly engage these models with near real-time hydrologic and climate forecasts as well as sea level rise scenarios. With the completion of the first round of CEPP, we are now taking time to re-evaluate, improve or replace some of these earlier models. Multiagency and university work is now underway on a new Cape Sable Seaside sparrow model and improvements to the American alligator production model and the Everglades landscape vegetation succession model (ELVeS). Reevaluations include compilation and assessments of new data, fire history as a critical spatial variable, transition from judgment-based deterministic modeling to increasingly empirical-based probabilistic approaches, and response variables and temporal scales appropriate for near real-time modeling applications. Lidar topography and bathymetery coming available starting later this year adds a new potential and new challenges in working with spatial resolutions that can be substantially higher than available in the past. Discussion and initial trials of new modeling will be presented.

<u>BIO</u>: Dr. Leonard Pearlstine is a landscape ecologist with 30 years' multi-disciplinary experience with spatial analysis, ecological modeling and wetland natural resource management. Prior to his position at the National Park Service, he served as research faculty in the University of Florida and the USGS Cooperative Fish and Wildlife Research Unit.

<u>Contact Information</u>: Leonard Pearlstine, Everglades National Park, South Florida National Resources Center, 950 N. Krome Ave., 3rd Floor, Homestead, FL, USA 33030, Phone: 305-224-4228, Email: leonard_pearlstine@nps.gov

EFFECT OF WATER-LEVEL FLUCTUATIONS ON RESOURCE SELECTION OF WADING BIRDS

***Michelle L. Petersen*[1] *and Dale E. Gawlik*[1]**
[1]Florida Atlantic University, Boca Raton, FL, USA

The management and conservation of anthropogenically altered ecosystems requires an understanding of the linkage between indicator species and environmental variables that represent high quality habitat. Wading bird species are sensitive to land use changes, chemical contamination, and fluctuating habitat conditions, and thus serve as important indicator species for wetland health. To understand resource selection by great egrets (*Ardea alba*), white ibis (*Eudocimus albus*), and wood storks (*Mycteria americana*), we created Resource Selection Functions (RSFs) for these species in the Florida Everglades, USA, a wetland with seasonally fluctuating water levels.

We obtained great egret, white ibis, and wood stork presence/absence data across the Everglades from the Systematic Reconnaissance Flight Survey (SRF) from 1993 through 2009. Surveys were conducted monthly January to June over approximately 1,300 2 km x 2 km grid for which we also obtained hydrologic data from the Everglades Depth Estimation Network (EDEN). We quantified spatiotemporal foraging-habitat selection using hierarchical multinomial logit models with fixed and random effects. An information-theoretic approach was conducted using Akaike Information Criterion (AIC) to investigate competing models.

Wading birds selected foraging sites based on similar hydrologic parameters, but the response varied by species. Wood storks were more likely to forage in shallow cells (< 10 cm) drying with high recession rates (0.5-1.5 cm/day), and high time since drydown (600 days). White ibises selected foraging cells with relatively shallow water depths (0 – 15 cm), intermediate recession rates (0.5-1.0 cm/day), and high days since drydown (600 days). Great egrets selected foraging cells with a wider range of water depths (0-20 cm) where recession rates were with lower (0.5 cm/day). All species were 3 times less likely to forage in cells where water increased by more than 3 cm in the previous two weeks. These differences in resource selections correspond to morphological and behavioral differences between the species, whereby wood storks are more constrained hydrologically and would be more affected by water manipulation.

BIO: Michelle Petersen is a Ph.D. Candidate at Florida Atlantic University. Her research focuses on ecological modeling of long-term data sets. Specifically, determining hydrologic drivers of wading bird nest abundance, foraging distribution, and foraging-habitat selection to aid in Everglades restoration.

Contact Information: Michelle L. Petersen, Department of Biological Sciences, Florida Atlantic University, Boca Raton, FL 33431 USA, Phone: 561-297-0671, Email:mpeter45@fau.edu

IMPROVING DRY-SEASON WATER SURFACES BY USING BELOW GROUND ESTIMATES FOR THE EVERGLADES DEPTH ESTIMATION NETWORK (EDEN)

Matthew D. Petkewich[1], *Bryan J. McCloskey*[2], *Heather S. Henkel*[3], *and Paul A. Conrads*[1]
[1] U.S. Geological Survey, South Atlantic Water Science Center, Columbia, SC, USA
[2] CNT, contracted to USGS St. Petersburg Coastal & Marine Science Center, St. Petersburg, FL, USA
[3] U.S. Geological Survey, St. Petersburg Coastal & Marine Science Center, St. Petersburg, FL, USA

The Everglades Depth Estimation Network (EDEN) consists of an integrated network of real-time water-level gaging stations, a ground-elevation model, and a water-surface elevation model designed to provide scientists, engineers, and water-resource managers with current (1991–2016) water-level and water-depth surfaces for the entire freshwater portion of the Everglades. The EDEN domain is presented on a grid consisting of more than fifty-thousand 400- by 400- meter cells and offers a consistent and documented dataset that can be used by scientists and water-resource managers to (1) guide large-scale field operations, (2) integrate hydrologic and ecological data and their analysis, and (3) support biological and ecological assessments that measure ecosystem responses to the Comprehensive Everglades Restoration Plan. The EDEN water-surface model interpolates measured median daily water levels from 223 stations in the EDEN continuous monitoring network to the 400- by 400-meter cells of the grid by using radial basis functions with multiquadric regression. The model produces a continuous water surface for any day within the period of record in the EDEN database.

The production of dry-season water surfaces is problematic when water levels drop below the water-level sensors at EDEN gages because measured or estimated data are required at every gage for model interpolation of the continuous water-elevation surfaces. Prior to 2012, water levels at dry gages were set to 0.01 foot below the last measured water level to enable the production of the continuous water-surface maps. Although this method allowed the production of water surface maps during the dry season, the EDEN team discovered that a preferred approach by some researchers would be to estimate the water level below land surface. Water surfaces produced using the -0.01-foot estimation method at a dry gage could bias the associated 400-square meter cell and, therefore, create a resulting median water-level surface that was probably higher than actual conditions. The dry-season results obtained by using this method could possibly have a negative effect on ecological models that use EDEN data. Beginning in 2012, to provide a more realistic estimate of water level at gages during the dry season, EDEN gages that were missing water-level data due to dry-season conditions were estimated below ground by using nearby groundwater wells or surface-water gages with topographically lower sensor placement. Currently (2016), the EDEN team is re-evaluating dry-season estimates for water-level gages prior to 2012. After estimating below ground water levels at gages that were previously set to dry values of 0.01 foot below the last measured value, new water-surface maps will be produced to replace the existing water surfaces.

BIO: Matthew Petkewich is a hydrologist with the U.S. Geological Survey. For the past 8 years he has helped automate the compilation and quality assurance and control of the Everglades Depth Estimation Network (EDEN) data as part of the production of EDEN daily water-level surfaces.

Contact Information: Matthew D. Petkewich, U.S. Geological Survey, South Atlantic Water Science Center, Stephenson Center, Suite 129, 720 Gracern Road, Columbia, SC USA 29205, Phone: 803-750-6171, Email: mdpetkew@usgs.gov

TRACKING LARGE-SCALE MOVEMENTS OF WOOD STORK IN THE GREATER EVERGLADES ECOSYSTEM

***Simona Picardi*[1]**, *Rena Borkhataria[2], Peter Frederick[3], Mathieu Basille[1]*
[1]Fort Lauderdale Research and Education Center, University of Florida, Davie, FL, USA
[2]Everglades Research and Education Center, University of Florida, Belle Glade, FL, USA
[3]University of Florida, Gainesville, FL, USA

Wood Storks are iconic wading birds inhabiting tropical and subtropical wetlands from the Southeastern US across Central and South America to northern Argentina. The Southeastern US Wood Stork population is the only breeding population found in North America, and it is listed as federally threatened under the Endangered Species Act. The Greater Everglades Ecosystem is of key importance for this population, as a large proportion of it breeds there during the winter. Wood Storks have been identified as indicators of habitat quality in the South Florida wetlands system, which makes them a relevant focal species for research and monitoring of ecosystem function.

The Wood Stork population in the Southeastern US shows a partial migration pattern, with some individuals nesting in South Florida in the winter and then migrating northward after the end of the breeding season, up to Georgia and South Carolina, while some others stay resident in the breeding grounds year-round. We used GPS technology to track more than 100 Wood Stork individuals over more than a decade and to investigate differences in individual patterns of migratory behavior. We used a random forest classification algorithm to distinguish behavioral modes and identify migration events along movement trajectories, which were then analyzed individually. We observed a wide variability in migration patterns both in terms of migration occurrence, geographic span, and spatio-temporal consistency. First, we showed that about 30% of the individuals in the population perform regular yearly migrations, while another 25% do not migrate on a regular basis, and the remaining 45% are residents. Second, we showed that for migratory individuals the displacement between breeding grounds and summer ranges can span from the scale of few kilometers to the scale of entire states. Third, we pointed out a wide inter-individual variability in terms of both migration timing and site-fidelity across years.

These results will allow us to identify factors determining migration patterns at the individual level, and to link migratory behavior with reproductive success. Ultimately, we will use this knowledge to project Wood Stork population performance under different global change scenarios, as a function of population composition in terms of migratory behaviors.

BIO: Simona is a PhD student in Dr. Basille's lab. Her research focuses on movement ecology of large vertebrates. She has extensive experience in the analysis of GPS-tracking data. Currently, Simona is investigating migration patterns of Wood Stork in the Southeastern US, and relating these with population vulnerability to global change.

Contact Information: Simona Picardi, Fort Lauderdale Research and Education Center, 3205 College Ave, Davie, FL, USA 33314, Phone: (352) 284-1779, Email: simona.picardi@ufl.edu

BIOGEOCHEMICAL VARIABLES DRIVING TEMPORAL DYNAMICS AND SPATIAL VARIABILITY IN MERCURY BIOACCUMULATION IN *GAMBUSIA* IN THE EVERGLADES – A MODEL ANALYSIS USING R-EMAP

***Curtis D. Pollman*[1]**, *Peter I. Kalla*[2], *and Daniel J. Scheidt*[2]
[1]*Aqua* Lux Lucis, Inc. and University of Florida, Gainesville, FL, USA
[2]U.S. Environmental Protection Agency, Athens, GA, USA

Data collected by the US EPA as part of their Regional Environmental Monitoring and Assessment Program (R-EMAP) indicate that the magnitude and distribution of mercury (Hg) concentrations in mosquitofish (*Gambusia spp*.) within the Everglades vary widely both spatially and across time. These spatial variations in magnitude and temporal dynamics in turn suggest that changes in ambient water chemistry can be causative, at least in part. Multivariate statistical modeling is one approach towards analyzing these variations, and to the extent such modeling succeeds or fails, the results can help elucidate the likely mechanisms governing Hg bioaccumulation in the Everglades.

Initiated in 1993, the R-EMAP effort in the Everglades has included collecting water quality, sediment, and biota samples throughout the marsh to establish its status with respect to ecosystem health. R-EMAP uses a generalized random tessellation stratified (RTS) design for selecting sites that ensures both full coverage of the marsh and facilitates estimating the population characteristics or distribution of critical water quality and other ecosystem health-related parameters throughout the Everglades. As a result, R-EMAP and, by extension, modeling based on R-EMAP, can provide a basis for determining the effectiveness of efforts designed to restore the Everglades. Sampling across the marsh has been conducted during 1995, 1996, 1999, and 2005 (both wet and dry seasons) and during 2013 (wet season only).

The R-EMAP sampling structural design is based on a series of polygons that define the fundamental sampling unit within a given major hydrologic unit, with samples during each wet or dry cycle collected at random from within each polygon. These polygons thus can form the basis for evaluating spatial variations in *Gambusia* Hg concentrations, and shifts in these spatial patterns over time. Because *Gambusia* Hg concentrations are expectedly a function of both exogenous and endogenous variables, we use structural equation modeling and instrumental variable regression to construct our multivariate models. Following evaluation of model robustness including a jackknife (leave-one-out) cross validation, we then compare model predictions for shifts in *Gambusia* Hg concentrations with observed shifts. The underlying variable changes driving these dynamics across time are then evaluated by perturbing individual variables while holding other model variables constant at the initial time value.

BIO: As Principal Scientist with *Aqua* Lux Lucis, Dr. Pollman specializes in using multivariate statistical methods to evaluate the critical variables governing biota response in complex data sets. Dr. Pollman has been engaged in biogeochemical studies and research for more that 30 years, including work in the Everglades beginning in 1992.

Contact Information: Curtis D. Pollman, *Aqua* Lux Lucis, Inc., 8411 NW 55th Place, Gainesville, FL, USA 326536, Phone: (352) 222-4039, Email: cpollman@aqualuxlucis.org

THE INFLUENCES OF DISSOLVED ORGANIC MATTER ON MERCURY BIOAVAILABILITY IN THE FLORIDA EVERGLADES: INSIGHTS ON ORGANIC SULFUR CHEMISTRY

Brett A. Poulin[1], *Joseph N. Ryan*[2], *Kathryn L. Nagy* [3], *Aron Stubbins*[4], *Thorsten Dittmar*[5], *William Orem*[6], *David P. Krabbenhoft*[7], *and George R. Aiken*[1]

[1]U.S. Geological Survey, Boulder, CO, USA.
[2]University of Colorado Boulder, Boulder, CO, USA.
[3]University of Illinois at Chicago, Chicago, IL, USA.
[4]Skidaway Institute of Oceanography, University of Georgia, Savannah, GA, USA.
[5]University of Oldenburg, Oldenburg, Germany.
[6]U.S. Geological Survey, Reston, VA, USA.
[7]U.S. Geological Survey, Middleton, WI, USA.

Dissolved organic matter (DOM) in the Florida Everglades controls a number of environmental processes important for ecosystem function including the absorption of light, mineral dissolution and precipitation, and the transport and reactivity of metals. Mercury (Hg) speciation and bioavailability in the Florida Everglades, in particular, are intimately linked to (i) sulfur cycling and (ii) interactions with DOM. In the absence of sulfide, DOM acts as a strong ligand that controls mercury speciation in aquatic systems. DOM forms exceptionally strong complexes with mercury through interactions with reduced sulfur groups (i.e., thiols). Under sulfate reducing conditions, which develop in response to anthropogenic sulfate inputs to Everglades wetlands, sulfide reacts with mercury to form nanocolloidal mercuric sulfide (HgS). DOM interacts strongly with nanocolloidal HgS to stabilize HgS clusters and slow particle growth kinetics. Mercury associated with nanocolloidal HgS is bioavailable to methylating organisms and becomes more bioavailable with (i) decreasing sulfide concentration, (ii) increasing DOM aromaticity, and (iii) increasing DOM reduced sulfur content. Understanding the processes that control DOM aromaticity and reduced sulfur content are critical to anticipate the effects of water management decisions on mercury bioavailability in the Everglades ecosystem.

We describe the processes controlling the reduced sulfur content of DOM in central Everglades wetlands. DOM was isolated from surface and pore waters at a variety of locations in Water Conservation Areas 1, 2A, and 3A; sampling locations varied in the degree of sulfate enrichment. DOM samples were analyzed by X-ray absorption spectroscopy and ultrahigh-resolution mass spectrometry, which provide complementary information on the chemistry of sulfur in DOM. A spatial dependence in DOM sulfur content and speciation was observed in Everglades wetlands that reflects the degree of sulfate enrichment and resulting sulfide concentrations in sediment pore waters. Sulfur is incorporated into DOM predominantly as highly reduced species (i.e., thiols) in sulfidic pore waters. DOM enriched in reduced sulfur in sediment pore waters exchanges with overlying surface waters and the sulfur undergoes oxidative transformations in the water column. The results identify sulfate inputs to the Everglades as a primary determinant on DOM sulfur chemistry, and suggest that transformations of DOM in northern wetlands may increase the reactivity of DOM exported to more pristine, southern reaches of the Everglades. Information gained here on DOM-sulfur chemistry provides a framework to evaluate DOM-sulfur dynamics in response to temporal fluctuations in sulfate loading, and builds on previous works that define the factors influencing mercury methylation in the Everglades ecosystem.

<u>BIO</u>: Dr. Poulin is a research chemist at the U.S. Geological Survey in Boulder, CO. His research focuses on understanding how the chemical nature of dissolved organic matter influences the environmental cycling of major elements (e.g., carbon, sulfur) and trace metal contaminants.

<u>Contact Information</u>: Brett Poulin, National Research Program – Central Branch, 3215 Marine St. STE E127, Boulder, CO, USA 80303, Phone: 303-541-3050, Email: bpoulin@usgs.gov

EVALUATION OF POTENTIAL FOR ROOTED FLOATING AQUATIC VEGETATION TO FURTHER REDUCE LOW-LEVEL PHOSPHORUS CONCENTRATIONS IN THE EVERGLADES STORMWATER TREATMENT AREAS

Matt Powers[1], *Mike Jerauld*[2]
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]DB Environmental, Inc., Rockledge, FL, USA

To date, the Everglades Stormwater Treatment Areas (STAs) have been successful in reducing total phosphorus (TP) concentrations in runoff water and thereby greatly reducing phosphorus inputs to the Everglades Protection Area. The STAs have reduced TP concentration to low-levels, i.e. period of record flow-weighted mean concentration of 32 µg/L for all STAs, with some STAs achieving closer to 20 µg/L. Further enhancement of vegetation-based treatment may be one of the paths to reaching the regulatory limit of 13 µg/L outflow concentrations from the STAs. This study will examine the potential of rooted floating aquatic vegetation (rFAV) as a means of further reducing low-level total phosphorus concentrations to ultra-low levels.

The rFAV species *Nymphaea odorata* (white water lily), *Nelumbo lutea* (American lotus), and *Nuphar lutea* (spatterdock), are frequently found in STAs where TP concentrations are below 20 µg/L. The influence of these rFAV species on TP concentrations is yet unknown, however, numerous studies have indicated that physical, chemical, and biological functions provided by rFAV in wetlands affect P storage and cycling and hence could lower the P concentration in the water column. The key mechanisms by which rFAV could improve STA performance include: i) reduced P diffusion from the soil to the overlying water, ii) provide resistance to flow and therefore promote particulate settling, iii) P uptake and sorption from the water column via large leaf blades and long petioles, and iv) providing longer-term P storage within its extensive root system. A preliminary study conducted using mesocosms has indicated that rFAV, specifically white water lily, combined with SAV has the potential to reduce TP concentrations to levels lower than SAV alone. For the present study, sites were selected in STA cells where natural recruitment of rFAV had occurred and where low-level TP concentrations are typical. Each monitoring location consists of two collocated sites, one in a patch of mixed rFAV and SAV and the second in SAV alone. To date, water quality samples have been taken at each site to characterize spatial variability within each site and temporal monitoring of water chemistry is underway. Soils cores were also collected within the selected vegetation patches and analyzed for bulk density, total phosphorus, total nitrogen, total carbon, total calcium, ash free dry weight, and NaHCO3-extractable soluble reactive phosphorus. Results from initial monitoring will be presented.

BIO: Matt Powers is a scientist with the South Florida Water Management District with over 10 years of experience in the fields of water quality monitoring and water quality treatment.

Contact Information: Matt Powers, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL, USA 33406, Phone: 561-791-4100 x4748, Email: mpowers@sfwmd.gov

THE EVERGLADES NATIONAL PARK AND BIG CYPRESS NATIONAL PRESERVE VEGETATION MAPPING PROJECT: REGION 2 – TAYLOR SLOUGH

Michelle Prats[1]*, Pablo L. Ruiz*[1] *and Theodore N. Schall*[2]
[1]National Park Service, Palmetto Bay, FL, USA.
[2]United States Army Corps of Engineers, Jacksonville, FL, USA.

The Everglades National Park (EVER) and Big Cypress National Preserve (BICY) vegetation mapping project is a cooperative effort between the South Florida Water Management District, the United States Army Corps of Engineers, and the National Park Service. This project employs a grid-based mapping approach as opposed to the traditional vector-based methodologies. Due to the spatial extent of this project (7,444 km^2; 1.84 million acres), the area is divided into seven regions, four in EVER and two in BICY. Photo-interpretation is performed by superimposing a 50 m x 50 m grid network over stereoscopic color-infrared aerial imagery on a digital photogrammetric workstation. Photo-interpreters identify the dominant vegetation community in each cell based on community specific spectral signatures and extensive ground-truth data, using a hierarchical classification system.

To date, approximately 59% of EVER has been mapped, Regions 1-4. The mapping of Region 2, Taylor Slough, is complete and has an overall estimated accuracy of 88.6% with a 90th percentile confidence interval of 84.6%. A total of 132 unique thematic classes were identified within Region 2. Of these, 112 (85%), accounted for less than one percent of the map. The most common vegetation class are Red Mangrove Scrub-Open Marsh (17.9%), Short Sawgrass Marsh-Dense (8.6%), Transitional Bayhead Shrubland (7.2%), Red Mangrove Scrub-Sawgrass Marsh (5.4%), Red Mangrove Scrub-Spikerush Marsh (4.6%), Spikerush Marsh (3.5%).

This project will provide essential baseline information needed to detect and document changes in the spatial extent, pattern, and proportion of plant communities within EVER and BICY as they respond to hydrological modifications due to restoration efforts and/or climate change related impacts. Additional ancillary products generated from this mapping project include a landscape level network of spatially specific vegetation data that includes species level relative abundance and georeferenced photographic documentation, landscape level distribution and cover maps for cattail and exotic species, as well as disturbance maps.

BIO: Michelle Prats is currently the data manager for the Everglades National Park and Big Cypress National Preserve vegetation mapping project. She completed her B.S. at Florida International University in Environmental Studies and has been working with the NPS for over 5 years under various projects.

Contact Information: Michelle Prats, South Florida/Caribbean Network Inventory and Monitoring Program, National Park Service, 18001 Old Cutler Rd, Suite 419, Palmetto Bay, FL, 33157, USA, 786-249-3015, michelle_prats@nps.gov.

SIGNIFICANCE OF GROUNDWATER DISCHARGE TO COASTAL ZONES

René M. Price
Florida International University, Miami, FL, USA

Saltwater intrudes along the entire coastline of south Florida, therefore, groundwater discharge to south Florida coastal zones is a mixture of fresh, brackish and saline groundwater. Each of those water types contains not only varying amounts of salinity, but also nutrients, trace elements, and carbon. Due to the low topography and reduced freshwater flows across the landscape, saltwater intrudes into the surficial aquifer creating a brackish mixing zone in the coastal aquifer that extends tens of kilometers inland of the coastline. The occurrence of that brackish mixing zone, along with the discharge of the brackish groundwater to the overlying surface water influences the overlying ecosystem. For instance, mangroves dominate across the landscape where brackish groundwater is known to occur. At low to moderate salinities, phosphorus can be released from the carbonate aquifer to the groundwater via a combination of adsorption and calcium carbonate mineral dissolution. Discharge of phosphorus-laden brackish groundwater to the surface water can influence primary production, which in turn can affect water clarity, and submerged aquatic vegetation. This presentation provides an overview of the hydrochemical and ecohydrological processes associated with saltwater intrusion and brackish groundwater discharge along the coastal Everglades. Understanding the biogeochemical mechanisms associated with saltwater intrusion and subsequent brackish groundwater discharge to the coastal regions of south Florida is important in understanding the overall ecosystem processes as well as their response to restoration efforts.

BIO: Dr. René Price is a professor in the Department of Earth and Environment and the Southeast Environmental Research center at Florida International University. She has more than 20 years of experience in conducting hydrological investigations of water flow and chemistry in south Florida and Everglades restoration projects.

Contact Information Dr. René Price, Florida International University, Department of Earth and Environment, 11200 SW 8th St., AHC5-373, Miami, FL 33199, Phone: 305-348-3119, Email: pricer@fiu.edu

HYDROLOGICAL CONTROL ON PHOSPHORUS CONCENTRATION IN THE EVERGLADES: THE ROLE OF WATER LEVEL DYNAMICS IN A MARSH-CANAL HYDROSYSTEM

Chelsea Qiu
South Florida Water Management District, West Palm Beach, FL, USA

Significant improvement in reducing phosphorus (P) concentration in discharges to the Everglades system has been achieved through the implementation of a series of water quality treatment and restoration programs over the last two decades. However, P enrichment remains a concern affecting the structure and function of the Everglades ecosystem. This study examined variations in total P (TP) concentrations at outflow structures in a marsh-canal Everglades system (Water Conservation Area 3A) in relation to hydrometric variables including rainfall, flow, and water levels (stages) as well as inflow TP concentrations using data collected from 2007 to 2014. The results indicated that TP concentrations vary at annual, monthly, and daily time scales while soluble reactive P was found to be mostly under the detection limit (2 µg/L). Stage in the marsh-canal system was the most important hydrological variable influencing TP changes with a Pearson r of about -0.8 and the largest factor loading with TP from a principle component analysis/factor analysis. Time series data revealed that TP concentrations start to increase as stage in the canal becomes lower than in the marsh during the dry season. The high TP concentrations are attributed to the mobilization of the ubiquitous floc layer in the system by moving water or disturbance-suspension as the stage becomes low, leading to significant TP loading internal to the system. This stage-driven TP transport within the marsh-canal system, in contrast to common belief of upstream TP loading, explains high TP concentrations at outflow structures, especially the ones receiving marsh flow. While there is a continuing need to reduce external P loading to the Everglades as a whole, the significance of the internal loading and redistribution of TP associated with mobilization of the floc layer in the ridge-slough system deserves further study.

BIO: Dr. Chelsea Qiu is a senior engineer at the South Florida Water Management District. During the past 20 years, Dr. Qiu has worked extensively on water management issues in south Florida through data synthesis and computational modeling. Her most recent work has been on water quality and hydrologic analysis of the Everglades.

Contact Information: Chelsea Qiu, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL, USA 33406, Phone: 561-682-6196, Email: cqiu@sfwmd.gov

ECOSYSTEM RECOVERY FOLLOWING IMPLEMENTATION OF WEED BIOLOGICAL CONTROL: *MELALEUCA QUINQUENERVIA* AS AN EXAMPLE.

Min B. Rayamajhi*[1]*, *Philip W. Tipping*[1], *Paul D. Pratt*[2], *Ted D. Center*[3], *Jorge Leidi*[1] *and Melissa Smith*[1]
[1]USDA/ARS Invasive Plant Research Laboratory, Fort Lauderdale, FL, USA
[2]USDA/ARS, Exotic & Invasive Weeds Research, Albany CA, USA
[3]Retired, Fort Lauderdale, FL USA

The ultimate goal of a biological control program against an invasive weed is to suppress its population so that it no longer continues to expand and cause havoc to its adventive environment, instead turns into a minor component of the plant diversity of an ecosystem. Weed biological control should reverse environmental degradation through a slow but steady landscape-wide rehabilitation process without causing collateral damage to the biotic and abiotic environment of a target ecosystem. *Melaleuca quinquenervia* (melaleuca) biological control in Florida elucidates some of the above mentioned benefits a weed biological control program can offer to an environmentally degraded ecosystem.

Melaleuca is an invasive tree of Australian origin, introduced in Florida over a century ago. Since then it has colonized various ecologically sensitive habitats including the Florida Everglades, displaced native vegetation and created near monotypic melaleuca tree islands. Biological, chemical, mechanical, cultural, and legislative approaches have been deployed to manage melaleuca's environmental impact since mid-1990s. In the biological control approach, a suite of four herbivorous insects: *Oxyops vitiosa* (weevil), *Boreioglycaspis melaleucae* (psyllid) and *Lophodiplosis trifida* (stem-galling cecid), *Fergusonina turneri* (gall-fly) have been imported from Australia and released in Florida. About 3.5 million of these herbivorous insects have been released in and around the Florida Everglades alone. In an effort to quantify biological control impact on melaleuca and native vegetation, six permanent plots (2 of each three tree-sizes, i.e., small, medium and large tree) measuring 25-100 m^2 were established (during 1996-97) in each of the two sites representing three habitat types (permanently inundated, seasonally inundated, and occasionally inundated). Each site had two treatments: biological agent treatment and control (no biological agent) in southern Florida. Weevils and psyllids were released into the insect plots and the sites were monitored for weevil, melaleuca, and non-melaleuca plant performance. By 2004, three of the four original sites were lost to wild-fires and herbicide applications, leaving only an occasionally inundated habitat in Broward County where the biological control impact study continued for 17 years (1997-2014).

Our research documented a rapid decline in melaleuca density, a fluctuation of the density of biological control agents while the monotypic melaleuca stand gradually changed to a more diverse plant community with 85% fewer melaleuca trees. Plant family and species richness increased several fold during the 17-year period. The majority of the plants returning to the gaps created by melaleuca tree mortality were comprised of native species. These findings have demonstrated significant negative impacts of biological control on melaleuca's invasive attributes, leading to the gradual recovery and rehabilitation of degraded plant communities. This process is undoubtedly occurring in most melaleuca infestations, but at different rates and levels. Developing new agents and augmenting existing agents may accelerate melaleuca suppression in some of the more ecologically sensitive areas where other management methods deem unsuitable.

BIO: Dr. Min Rayamajhi is one of the research scientists at the USDA/ARS, Invasive Plant Research Lab in Fort Lauderdale, FL. He was involved in melaleuca biological control research and implementation for 17 years. Currently, he is working in a project involving air potato biological control impact evaluation in Florida.

Contact Information: Min Rayamajhi, USDA/ARS Invasive Plant Research Lab, 3225 College Avenue, Fort Lauderdale, FL 33314, Phone: 954-475-6552, Email: min.rayamajhi@ars.usda.gov

TROJAN Y FOR CONTROL OF NON-NATIVE FISHES: MOVING FROM THEORY TO PRACTICAL APPLICATION

Pamela J. Schofield[1], ***Kristen Reaver***[2], *Margaret Hunter*[1], *Rana Parshad*[3]
[1]US Geological Survey, Gainesville, FL, USA
[2]Cherokee Nations, Gainesville, FL, USA
[3]Clarkson University, New York, NY, USA

Once an invasive fish species has established a reproducing population and spread over large, interconnected waterways, it is nearly impossible to control the population with traditional methods (e.g., poisons, physical removal). Furthermore, most methods of fish control are costly and can have severe negative consequences for native species and habitats, making them impractical. A new technique for controlling populations of established species relies on augmenting wild populations with individuals that are phenotypically sex-reversed from the expected genotype (i.e., carriers of Trojan Y chromosomes). In theory, the addition of females carrying two Y chromosomes into a population with an XY sex-determination system should cause a disproportionate influx of Y chromosomes into subsequent generations and bias the overall sex ratio towards males. Computer models have shown that introducing a small proportion of Trojan Y carriers into an established population can lead to extinction in the wild as females become fewer and fewer.

The Trojan Y concept is appealing, but as of today only exists in theory and its utility to control populations has not been tested in a live-animal model. Researchers at the US Geological Survey (Gainesville, FL) are determining whether the Trojan Y strategy is feasible. To do this, the first question researchers must ask is: What does it take to create a Trojan Y fish? We present our ongoing work developing a YY guppy (*Poecilia reticulata*), including the breeding process necessary to produce a YY fish and our struggles and successes. Data from our laboratory research highlight the challenges of moving from theory to practical application of the Trojan Y strategy and how we are modifying the strategy to make it more useful. We also detail our collaborations with mathematicians and geneticists and explain how their expertise moves the project forward.

<u>BIO</u>: Dr. Schofield studies various aspects of non-native fish biology and ecology, including their impacts on native fauna.

<u>Contact Information</u>: Pamela Schofield, USGS; 7920 NW 71st Street, Gainesville, FL 32653; pschofield@usgs.gov

UNDERSTANDING HOW SNOOK RESPOND TO THE HYDROLOGICAL LANDSCAPE: SYNCHRONY IN MOVEMENT OVER TIME

Jennifer S. Rehage[1], *Ross E. Boucek*[2], *Rolando O. Santos*[1]
[1]Florida International University, Miami, FL, USA
[2] Florida Fish and Wildlife Commission, St Petersburg, FL, USA

Upon environmental change, organisms may respond by either (1) adjusting, (2) adapting or 3) moving. Thus movement is a critical mechanism by which organism responds to environmental variation. Further, recent technological advancements allow us to track movement and space use in an unprecedented details, with higher accuracy, higher spatiotemporal resolution, and on a broader scope of species and habitats. A key contribution of these technological advances is the ability to quantity variation among individuals. Organisms with varying phenotypes, including traits such as personality type are known to respond differently to spatiotemporal heterogeneity in foraging, habitat, mating and predation conditions. At the same time, we may expect certain disturbance events to 'synchronize' animal movements and distribution in space. For instance, seasonal marsh drying may cause a pulse of prey and higher foraging quality in habitat a, relative to habitat b, which should cause organisms to move from habitat b to habitat a, causing a certain level of spatial synchrony in animal distribution.

In this study we asked, does disturbance cause spatial synchrony in Common Snook? To address this question, we examined the spatial distribution of acoustically tagged fish in the Shark River, Everglades National Park in response to seasonal and yearly variation in hydrological conditions. The space use of over 60 fish were tracked over a period of four years. Analysis show that spatial synchrony is more limited than expected and is largely overwhelmed by individual variation. A degree of responsiveness by fish to temporal heterogeneity in conditions is observable in s subset of the tag population, but varying movement strategies, ranging from high site fidelity and low movement to hyper responsive and high movement were documented. Most individuals have a low probability of switching habitats or increasing movement as conditions change across seasons. However, despite this, behavioral strategies are not fixed. Individuals tracked multiple years showed changing strategies over time. Our findings emphasize the role of animal behavior in mediating the response of organisms to changing conditions.

<u>BIO</u>: Dr. Jennifer Rehage is a fish ecologist and associate professor at Florida International University. Her research examines the interacting effects of water, climate, and management decisions on fish across ultiple scales, from their individual behavior to populations and communities, and including socioecological scales, and involves recreational anglers in citizen science.

<u>Contact Information</u>: JS Rehage, Florida International University, 11200 SW 8th St., Miami, FL, USA 33199, Phone: 304-348-3804, Email: rehagej@fiu.edu

INVESTIGATING THE EFFECTS OF LAND-USE CHANGE ON THE HYDROLOGIC CONDITIONS OF A RESTORED AGRICULTURAL AREA IN EVERGLADES NATIONAL PARK

Dillon Reio *and René Price*
Florida International University, Miami, FL, USA

In the Florida Everglades, one of the most important and diverse wetland ecosystems in the world, anthropogenic changes, specifically remodeling of natural wetlands to promote agriculture and human settlement, have profoundly altered its hydrology and functionality. When the state of Florida appropriated the land that makes up Everglades National Park (ENP), there were certain plots of productive agricultural land, collectively termed the Hole-in-the-Donut (HID), that were permitted to continue farming. Decades of farming and agricultural practices, namely rock plowing and fertilizer addition, altered the normally flat and oligotrophic landscape, respectively. These anthropogenic modifications in the HID facilitated the invasion of a noxious exotic species, Brazilian Peppertree (*Schinus Terebinthifolius).* In order to eradicate the exotic species and restore the natural biodiversity of the HID, land managers from the park employed a technique whereby the soil substrate was completely removed down to the bedrock.

The objective of this study is to determine whether groundwater levels and groundwater chemistry have been impacted as a result of the restoration technique. For this purpose, it is necessary to understand how restoration of former agricultural lands impacts the hydrology of the restored land as well as the surrounding landscape.

This study will rely on long-term monitoring of groundwater levels and sampling of groundwater chemistry to ascertain changes in local hydrologic conditions associated with historical land-use change. The various land use changes in the HID, from agriculture to a monoculture of Brazilian Peppertree to a reclaimed wetland, are expected to change local hydrologic conditions. Furthermore, changes in the soil in the HID, from a thick rock-plowed soil high in nutrients to complete removal followed by marl accumulation are expected to influence the chemistry of the water infiltrating to the groundwater table.

BIO: Dillon Reio is a second year Graduate Student in the Department of Earth and Environment at Florida International University. His research interests are in environmental hydrology, hydrologic modeling, and wetland restoration. This is his first time presenting a scientific research poster at a major conference.

Contact Information: Dillon Reio, Florida International University Hydrogeology Laboratory, 11200 SW 8th St, Miami, FL, USA 33199, Phone: 240-449-7783, Email: dreio001@fiu.edu

SEVEN DECADES OF MANGROVE EXPANSION ALONG COASTAL EVERGLADES: A REMOTE SENSING APPROACH

Vanessa Reyes[1], *Shimon Wdowinski*[1], *and Emanuelle Feliciano*[2]
[1]Florida International University FL, USA
[2]NASA Goddard Space Flight Center, Greenbelt, MD, USA

The area occupied by the mangrove forest along the coastal Everglades has changed over the past decades due to various environmental and physical causes. The main contributing factors for mangrove expansion into the intertidal brackish environments is salinity increase due to sea level rise and decrease of freshwater flow from inland wetlands to the coast. The impact of salinity changes on the vegetation also depends on other parameters, as land gradient and tidal channels.

In this research, we apply remote sensing techniques to identify mangrove forest expansion along the coastal Everglades from 1940 to 2013. The methodology consists of three stages. In the first stage, we analyze a 1940 aerial photo dataset, which consists of georeferenced 1m pixel resolution images available at the SOFIA website (South Florida Satellite Image Maps http://sofia.usgs.gov/exchange/aerial-photos/). We use object-based classification to segment these panchromatic images to identify the boundaries of the mangrove forest in 1940.

In the second stage, we exploit 2013 RapidEye multispectral satellite images with 6.6 m pixel resolution. This dataset is classified using pixel-based algorithms, taking advantage of the distinctive contrast of the spectral signature of the mangroves versus the other land cover units in the area. The last stage comprises the comparison between the results of the two previous stages to determine the mangrove expansion area, which also allow us to calculate expansion rate over this 73-year time period.

As a preliminary result, we detected areas with considerable mangrove expansion and identified the following three major mangrove colonization patterns:
Fingering pattern – Colonization occurs mainly along tidal channels in the western Everglades. The colonization extends mangrove forest distribution inland both perpendicular to channels and further east along channels.
Blanket-like pattern – Colonization occurs along a wide front in the southwest Everglades.
Sporadic colonization – Limited colonization occurs within the “white zone”, which is a wide almost vegetation-free area located in the northern section of southern shore’s intertidal zone.

BIO: Vanessa Reyes is a Geological Engineer who works as research assistant at Florida International University (FIU) with experience in remote sensing, Geographic Information Systems, and sub-surface geology.

Contact Information: Vanessa Reyes Olvera, Research Assistant, Department of Earth and Environment, Florida International University 11200 SW 8th Street, AHC5-388, Miami, FL 33199, USA, Cell: 305 842 4099, Email: ing.vanessa.reyes@gmail.com

FISH BIOACOUSTIC ACTIVITY IN EVERGLADES NATIONAL PARK: PROCESSING AND SCALING FOR EFFECTIVE RESTORATION AND MANAGEMENT

Aaron N. Rice[1], *Madeline L. Pielmeier*[1], *and Erik Stabenau*[2]
[1]Cornell University, Ithaca, NY, USA
[2]Everglades National Park, Homestead, FL

Passive acoustic recordings provide a promising survey methodology to quantitatively evaluate community responses to environmental change in the context of conservation and restoration efforts. Acoustic communication plays an integral role in the life history of many marine vertebrates, especially marine mammals and fishes. Unlike other communication modalities, acoustic communication can be observed remotely and passively, and used to assess species-specific patterns of occurrence and behavior. These surveys result in a permanent historical record that can be used to investigate a wide variety of species and habitat conditions.

We used acoustic recordings combined with oceanographic measurement stations to evaluate changes in patterns of fish ecology and reproduction as a function of changing environmental conditions and ongoing restoration efforts. We use this innovative conservation technology approach to establish a current baseline pattern of fish acoustic activity across Florida Bay throughout the year (with a focus on spotted seatrout and Gulf toadfish), and evaluate how fish populations respond to environmental changes, particularly changes in freshwater flow originating from Lake Okechobee. These results will provide critical information on the behavior and ecology of fishes within the Everglades, revealing how population-level acoustic activity changes with environmental conditions in Florida Bay. The observed ecological responses will directly inform adaptive management strategies of the park. This project will also demonstrate how passive acoustic fish surveys can be used as an effective approach to increase understanding of broader management, conservation, and restoration efforts across Florida Bay and Everglades National Park.

While acoustic surveys provide immense potential for temporal and spatial coverage of focal areas, they generate large volumes of data. With the maturation of digital audio recording capabilities and increased storage capacities, it is now relatively easy to collect data and the principle challenge becomes analyzing the data. A year-round, multi-sensor survey generates many years of audio data requiring terabytes of storage. We discuss our results from this project in the context of the methodological challenges and opportunities of passive acoustic monitoring, and make recommendations for future efforts for Everglades natural resource management.

<u>BIO</u>: Dr. Rice is at the Bioacoustics Research Program where he and his team use animal sounds to answer ecological questions in different ecosystems. His research focuses on fishes and marine mammals around the world in order to understand patterns of population dynamics, ecosystem function, and human influences on the environment.

<u>Contact Information</u>: Aaron Rice, Bioacoustics Research Program, Cornell Laboratory of Ornithology, Cornell University, 159 Sapsucker Woods Rd., Ithaca, NY 14850-1999, Phone: 607.254.2178, Email: arice@cornell.edu

VEGETATION EFFECTS ON MICROBIAL ENZYME ACTIVITIES IN SOILS OF THE STORMWATER TREATMENT AREAS

Patrick W. Inglett[1], ***Kaylee Rice***[1], *Kanika S. Inglett*[1], *Kathy Pietro*[2]
[1]University of Florida, Gainesville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

In stormwater treatment areas (STA) of the Everglades, microbial enzyme activity plays an essential role in nutrient removal by affecting stable soil accretion, breakdown of organic forms, and indicating patterns of nutrient limitation in the system. STAs have two dominant vegetation types (SAV and EAV), however little is known about how differences in these communities (organic matter quality, pH, and DO) may affect enzyme expression. This study determined enzyme activities for carbon (C, β-glucosidase), nitrogen (N, Leucine aminopeptidase/β-N-acetyl glucosaminidase), and phosphorus (P, phosphomonoesterase/ phosphodiesterase) in surface floc and recently accreted soil (RAS) materials collected along transect sites in Cell 1 (EAV) and Cell 3 (SAV) of STA 2. In general, enzyme activities of EAV and SAV showed similar inflow to outflow gradient s in both floc and RAS materials, but RAS presented a distinct trend as compared to floc which was much more variable. Both EAV and SAV displayed higher P enzyme activity at the outflow than at the inflow, however SAV showed the highest phosphatase activity in floc, while in EAV, RAS samples expressed greater overall P limitation. Differences between floc and RAS likely reflected the differences in stage of decomposition with RAS materials being composed of more recalcitrant C fractions. Similarly, enzyme C:N of EAV was in general greater than that of SAV and could be explained by higher cellulose and lignin content in EAV. Results of this study indicate clear differences between vegetation types in the STA specifically on microbial decomposition and nutrient limitation. Understanding patterns of nutrient limitation in the STAs has implications for decomposition, nutrient uptake by plants, and overall nutrient retention in the systems. When coupled with other biogeochemical processes (e.g., microbial respiration and mineralization), results of this study could lead to a better understanding of enzyme expression and a better understanding of microbial decomposition processes involved in nutrient removal which would be useful in formulating management strategies to further enhance the performance in the STAs.

BIO: Kaylee Rice is a graduate student at the University of Florida in the Wetland Biogeochemistry Laboratory under Dr. Patrick Inglett. Her research involves microbial enzyme activities in the stormwater treatment areas of the Everglades.

Contact Information: Kaylee Rice, Wetland Biogeochemistry Laboratory, 2181 McCarty Hall A, Box 110290, Gainesville, Florida 32611, Phone: 918-261-2773, Email: k.rice@ufl.edu

THE LANDSCAPE CONTEXT FOR REMAP IV: PLANT COMMUNITY DISTRIBUTION AND COVER DERIVED FROM VEGETATION MAPPED WITH WORLDVIEW2 SATELLITE DATA

Jennifer Richards[1], *Daniel Gann*[2] *and Peter Kalla*[3]
[1]Dept. of Biological Sciences and SERC, Florida International University, Miami, FL USA
[2]GIS/RS Center, Florida International University, Miami, FL USA
[3]United States Environmental Protection Agency, Athens, Region 4, GA, USA

Vegetation mapping provides a landscape context for REMAP biogeochemical and biotic information. In REMAP IV we trained computer algorithms to classify satellite imagery of a 1 km^2 area centered on each REMAP point. We used 33 of Digital Globe's WorldView-2 satellite images collected between 11/6/2010 and 9/22/2013 to map 1 km^2 sites around a subset of 65 of the 2014 REMAP points. Sites were distributed across the ecosystem with 22 in Everglades National Park (ENP), one in Big Cypress National Park, 29 in Water Conservation Area (WCA) 3, seven in WCA 2, and six in WCA 1. To train the classification algorithms, app. 3000 to 6000 training points were digitized in each 1 km^2 in ArcGIS. A random forest classifier method used the data from the training points to classify the remaining points in the 1 km^2 area. Initial maps were filtered to a 5 pixel (20 m^2) minimum mapping unit to create the final maps. We mapped and performed accuracy assessment on 48 vegetation classes. Community abundances were generated based on map coverage. Data for coverage from 4 pure sawgrass classes were used to estimate sawgrass biomass. Estimates for biomass/m^2 per sawgrass class were based on published data for sawgrass biomass and were made for aboveground live biomass, as well as above- and belowground biomass and total biomass; estimates of biomass/m^2 differed by class. The class-specific estimates of biomass/m^2 were multiplied by the number of m^2 per class for each mapped 1 km^2 site, and total biomass per site was derived by summing the sawgrass class totals per site.

The 65 maps covered a range of habitat types from relatively pristine ridge and slough, marl prairie, or freshwater marsh to highly modified habitats with dissected landforms or abundant cattail and shrubby marshes. Woody vegetation was present either as cypress domes or strands, elongated tree or shrub islands, or rounded tree or shrub islands. Only one map was in the mangrove ecotone.

The number of classes identified in each 1 km^2 varied from 6 to 18. The five most commonly occurring classes were three sawgrass classes (normal, sparse, and dense sawgrass), graminoid marsh and periphyton. Sawgrass was found to be less abundant than historical estimates for sawgrass. All sawgrass classes combined covered 47.7% of the area mapped, while pure sawgrass classes covered 43.1%. The average total area of sawgrass per 1 km^2 site was 42.3 ± 22.1 ha. This area differed significantly among regions (LNWR = 20.1 ± 11.5, WCA2 = 54.0 ± 24.6, WCA3 = 45.9 ± 21.6, and ENP = 41.2 ± 21.3). The number of classes per site increased between 0.04 ha (400 m^2) and 4 ha, but there was not a similar increase in class number between 4 ha and 100 ha (1 km^2).

The average sawgrass biomass per site was 715,017 ± 510,504 kg, while the average live aboveground sawgrass biomass per site was 292,994 ± 203,235 kg. The total sawgrass biomass estimated for the 65 sites was 46,476.095 metric tons, while the total live aboveground sawgrass biomass was 18,980.250 metric tons. Regions differed significantly in the biomass of sawgrass per site.

BIO: Dr. Richards is a botanist and wetland plant ecologist who has worked on Everglades plant biology for more than 30 years. Over the past 10 years, she and D. Gann have worked to develop remote sensing methods to map Everglades vegetation in support of Everglades restoration goals.

Contact Information: Jennifer Richards, Dept. of Biological Sciences, Florida International University, 11200 SW 8th St, Miami, FL, USA 33199, Phone: 305-348-3102, Email: richards@fiu.edu

A CONSERVATION GENETIC ASSESSMENT OF THE FLORIDA SNAIL KITE

Ellen P. Robertson[1], *James D. Austin*[1], *Robert J. Fletcher, Jr.*[1]
[1]University of Florida, Gainesville, FL, USA

Genetic structure and genetic diversity are key population characteristics that can inform conservation decisions. For example, evidence of genetic structuring in the Florida snail kite, a highly mobile raptor that has been assumed to be panmictic, would have implications for monitoring and planning decisions. This issue is relevant for interpreting recovery of snail kites in the Greater Everglades Ecosystem because kites breed in areas ranging from the Kissimmee River Valley to Everglades National Park. Recent findings indicate that dispersal declines with distance and there is less movement between northern (e.g., Kissimmee River Valley) and southern (e.g., Water Conservation Areas, Everglades National Park) parts of the range than within these regions. To help address this apparent disconnect, a genetic study to test for population substructure is needed. We genotyped 235 nestling snail kites sampled across the entire breeding range between 2013 and 2014 at 18 microsatellite loci and examined neutral genetic structure and genetic diversity. We found that the population is genetically panmictic with no evidence for genetic structure or genetic isolation by distance. We also found that genetic diversity is relatively low in this population compared with other raptor species, raising concerns for the risk of problems such as inbreeding depression or reduced long-term evolutionary potential within this species. Our results emphasize the importance of managing snail kites as a single population as gene flow is high across all breeding wetlands.

BIO: Ellen Robertson is a PhD Candidate in the Wildlife Ecology and Conservation Department at the University of Florida. She is interested in connectivity, breeding biology, and genetic issues for species of conservation concern. Her work has focused on wetland species including marsh birds and the endangered Florida Snail Kite.

Contact Information: Ellen Robertson, Email: ellen.robertson@ufl.edu

UNIQUE HYDROLOGIC EVENTS DURING THE 2015-16 HYDROLOGIC YEAR PROVIDE FURTHER INCITE INTO THE EFFECTIVENESS OF THE C-111 SPREADER CANAL WESTERN PROJECT

*Jerome J. Lorenz, **Michelle Robinson**, Mike Kline and Peter Frezza*
Audubon Florida Everglades Science Center, Tavernier, FL, USA

The C-111 Spreader Canal Western Project (C-111 SCWP) was completed in January 2012 and began functioning in May of that year. The project was designed to ameliorate the problem of ground water seepage from Taylor Slough to the C-111 canal. The goal of this project was to increase freshwater flow through Taylor Slough to Florida Bay by reducing losses to the canal system with the express purpose of promoting more natural physical conditions in northeastern Florida Bay. The intended outcome was to create more favorable ecological conditions downstream that would result in increased submerged aquatic vegetation (SAV) and higher prey base fish production that favor successful nesting of colonial water birds in northeastern Florida Bay. Our ecological monitoring program has been systematically collecting hydrologic, SAV and prey base fish data in the mangrove zone north of Florida Bay since 1996. The mangrove fringe is critical foraging habitat for myriad piscivorous predators. This monitoring program was designed specifically to examine the ecological responses to water management practices that influence freshwater flow through the C-111 and Taylor Slough. We predicted that if the project performed as models indicated, the ecological response would be an increase in overall SAV, a change in fish community structure and a gradual increase in fish biomass. At previous conferences, we have provided evaluations of how effective the project was after two and three years of operations with conclusions that we considered preliminary. Unique climatological and operational conditions during the 2015-16 hydrologic year (the fourth year of project operations) provided interesting opportunities in evaluating the project further. These conditions were 1) the lowest rainfall during the wet season in our period of record; 2) emergency operations by water managers to alleviate the wet season drought conditions; 3) one of the highest rainfall dry seasons in our period of record; and 4) the highest annual recorded sea surface elevations in the Gulf of Mexico. These unique conditions led us to evaluate our data on a seasonal basis for the 2015-16 hydrologic years. The results support previous findings that Taylor Slough remains primarily a rainfall driven watershed with little hydrologic influence from the greater Everglades watershed. When rainfall conditions are moderate to high, the C-111 SCWP appeared to perform well in redistributing water between the C-111 and Taylor Slough, however, in low rainfall to drought conditions, the lack of connectivity with the greater Everglades rendered the project ineffective. Our preliminary conclusion is that the C-111 SCWP appears to have benefits in correcting timing and distribution issues with the C-111/Taylor Slough basin but falls well short in correcting quantity issues, a condition we expect to continue until restoration efforts re-establish the natural hydrologic connection between Shark River Slough and Taylor Slough across the Rocky Glades.

BIO: Michelle Robinson is senior staff biologist for Audubon's Everglades Science Center and has been studying mangrove prey base fish dynamics for 13 years and has focused on using this data to evaluate the operations of the C-111 canal.

Contact Information: Michelle Robinson, Everglades Science Center, Audubon Florida, 115 Indian Mound Trail, Tavernier FL, USA 33070, Phone: 305-852-5318, Email: mrobinson@audubon.org

RELATIONSHIP BETWEEN INVASIVE WILDLIFE AND ECOSYSTEM RESTORATION IN THE FLORIDA EVERGLADES

Michael R. Rochford*, Jennifer Ketterlin Eckles, and Frank J. Mazzotti*

University of Florida, Fort Lauderdale Research and Education Center, Davie, FL USA

Florida has more nonnative reptiles and amphibians than anywhere else in the world with more than 180 introduced species and more than 60 that are established. South Florida is particularly susceptible to nonnative wildlife invasions as a result of its subtropical climate, island-like geography, major ports of entry for plants and animals into the United States, thriving trade in exotic pets, and occasional destructive hurricanes which increase risk of escapes. Natural systems are under increasing threat of invasion by nonnative wildlife species, including nonnative fish, amphibians, reptiles, birds, and mammals. Burmese pythons and Cuban tree frogs are already established in some of the most remote Everglades natural areas and Nile monitors, northern African pythons, tegu lizards, and spectacled caiman have all been found on or near State and DOI lands. Although fishes and reptiles have been of primary concern, amphibians (Cuban tree frogs), birds (sacred ibis, purple swamp hens) and macro-invertebrates (New Guinea flatworm) all potentially threaten the Everglades and ecosystem restoration.

Threats to ecosystem restoration can be both biological and structural. Biological threats include displacement or elimination of native species through competition, predation, grazing, disturbance, and spread of disease. Direct impacts of invasive wildlife can cascade through an ecosystem by mechanisms such as trophic collapse. Invasive wildlife have the potential to compromise the structural integrity of water control structures such as levees and berms by creating extensive burrow systems. Although we recognize instances where an invasive species may benefit a native species, we consider those instances as contrary to the Everglades Ecosystem restoration goal of restoration of native biological diversity. There is also potential for ecosystem restoration to affect invasive wildlife. Removal of canals, berms, and levees will slow the spread of some species of wildlife such as large constrictor snakes, and monitor and tegu lizards. We know of no examples where leaving these structures in place would slow the spread of invasive wildlife. Radio telemetry studies suggest that restoration of depth and period of inundation of Everglades wetlands could make them less suitable as habitat for species such as Burmese pythons and Argentine black and white tegus. We hypothesize that, overall, a restored ecosystem will be more resilient to invasion than a disturbed ecosystem.

The contribution that restoration of Greater Everglades ecosystems can make to solve the problem of invasive wildlife is to make invasive wildlife removal as much a part of ecosystem restoration as invasive plant removal. Just as for plants; even if we get the hydrology right we could still get restoration wrong if we end up with an Everglades overrun by invasive wildlife. If we have learned anything from existing wildlife invasions is that if we wish to get from behind the eight ball to ahead of the curve we need to institute a system-wide early detection, rapid response and removal program for invasive wildlife.

BIO: Mike Rochford has spent ten years as a wildlife biologist battling invasive herpetofauna in southern Florida. He has extensive experience with radio-telemetry, removal, and diet studies of Burmese pythons, Argentine black and white tegus, Nile monitors, spectacled caiman, and chameleons.

Contact Information: Michael Rochford, University of Florida, Fort Lauderdale Research and Education Center, 3205 College Ave, Fort Lauderdale, FL, USA 33314, Phone: 954-577-6418, Email: miker@ufl.edu

INFLUENCE OF CARBON LABILITY AND FLOODING TREATMENT IN POTENTIAL OXIDATION OF HISTOSOLS IN THE EVERGLADES AGRICULTURAL AREA

***Andres F. Rodriguez*[1]**, *Samira Daroub*[1], *and Stefan Gerber*[2]
[1]Everglades Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, FL, USA
[2]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

Drainage of the Everglades Agricultural Area (EAA) soils has resulted in soil subsidence. Subsidence rates have been reduced compared to previous rates. Increases in mineral content, recalcitrant carbon, and higher water tables due to the use of best management practices are considered as possible causes for these reduction. The purpose of this research is to determine how the soil lability and water management affect subsidence rates. To determine the influence of these factors in soil subsidence the oxidation rates (CO_2 efflux) of shallow and deeper EAA soils exposed to four water management treatments are being evaluated. Additionally, measurements of NO_3-N, NH_4-N, soluble organic nitrogen (SON), and dissolved organic carbon (DOC) on leachates are being performed. Preliminary results indicate that the soils exposed to 2 days flooding – 12 days draining flooding cycles have the highest CO_2 efflux rates (between 52 and 157 mg of CO_2 C m^{-2} h^{-1}) of all water treatments. The NH_4-N in leachates is highest in flooded soils (0.46 to 0.86 mg L^{-1}) compared to drained soils, whereas NO_3-N shows the opposite trend with concentrations as high as 395 mg L^{-1} in shallow drained soils. The SON and DOC have similar trends with highest concentrations in the drained soils. In the case of DOC deeper soils appear to have higher concentrations (54 - 74 mg C L^{-1}) compared to shallow soils (35- 39 mg C L^{-1}). These preliminary results indicate that cycles of flooding might not be beneficial for soil conservation, and water management is of great importance controlling C and N cycling in subsiding histosols.

BIO: Mr. Rodriguez is a PhD student in the Soil and Water Sciences Department at the University of Florida. His current work focuses in soil subsidence in the Everglades Agricultural Area. Mr. Rodriguez has a BS in Biology from the National University of Colombia and a MS from Florida International University.

Contact Information: Andres Rodriguez, Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA 32611, Phone: 904-755-5370, Email: afrodriguez@ufl.edu

INTERAGENCY COORDINATION FOR THE MASS PRODUCTION AND DISTRIBUTION OF BIOLOGICAL CONTROL AGENTS

Eric Rohrig

Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL, USA

Invasive non-native plants and insects pose a significant threat to Florida's natural ecosystems and agricultural industries. As global commerce and travel has increased over the past 50+ years, so has the number of exotic pest introductions. Working to effectively control these invaders is an overwhelming task requiring coordinated efforts and multiple approaches. Biological control, the use of natural enemies, particularly insects, to reduce populations of exotic plant and insect pests, has been safely and successfully utilized to decrease and even control these pests in Florida for over 100 years. Governmental agencies, universities, and nonprofit organizations are working together to fund, research, and distribute effective biological control options. One noteworthy ongoing example is Florida's interagency air potato biological control program targeting *Dioscorea bulbifera* (Dioscoreaceae), a fast climbing exotic vine causing significant environmental impact in the southeast US. Collaboration between the United States Department of Agriculture (Agricultural Research Service and Animal Plant Health Inspection Service), Florida Department of Agriculture (Division of Plant Industry), and the University of Florida (Institute of Food and Agricultural Sciences) has led to the coordinated production and strategic distribution of over 500,000 *Lilioceris cheni* (Coleoptera: Chrysomelidae) leaf feeding beetles to approximately 50 Florida counties as well as the states of Georgia and Louisiana over the past 4 years. Interagency coordination can improve the quality, quantity, and timeline of research, public outreach, insect production and release, and overall program impact over that which can be achieved by a single agency.

<u>BIO</u>: Dr. Rohrig is Chief of the Methods Development and Biological Control Bureau of the Florida Department of Agriculture. He has 15 years of biological control experience and has worked on a multitude of projects involving a high degree of collaboration between various agencies and universities in the US and abroad.

<u>Contact Information</u>: Eric Rohrig, Florida Department of Agriculture and Consumer Services, Division of Plant Industry, 1911 SW 34 Street, Gainesville, Florida 32608, Phone: 352-395-4744, Email: Eric.Rohrig@freshfromflorida.com

IMPROVING THE DECISION-MAKING PROCESS FOR EARLY DETECTION AND RAPID RESPONSE ACTIONS

Christina M. Romagosa
Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA

The recognition of the Greater Everglades Ecosystem's uniqueness has led to a multibillion dollar restoration effort, the largest such effort in the world. While notable progress is being made, invasive species impacts can hinder these restoration efforts. Resource managers are struggling to find ways to address the current impacts of invasive species while also facing the threat of new invasions. A coordinated response to new nonnative species introductions involves science-based prioritization tools alongside information transfer to relevant decision makers. The South Florida Ecosystem Restoration Task Force's Invasive Species Strategic Action Framework has identified the rapid assessment of newly detected species as one of its goals associated with the implementation of early detection and rapid response efforts. Here, we describe the development of a decision support tool that provides a standardized and transparent process for ranking those nonnative species that warrant a rapid response after their detection within the Greater Everglades Ecosystem footprint.

This decision support tool was developed from a variety of existing invasive species ranking systems, information from the literature, and expert and resource manager input obtained during two technical meetings. This project used a cross-section of experts (research scientists and academics), resource managers, and decision makers with experience working in the geographical context of the Greater Everglades. Resource managers will be the end users of this tool; therefore, their participation throughout the tool's development informed project leaders of the most helpful metrics across various decision contexts.

The decision support tool prioritizes nonnative species through a scoring process organized through series of questions under two key sections: invasion potential and feasibility of control. Once a score is calculated for both of these sections, the assessor is directed to a matrix that compares these scores and provides context for management action. Uncertainty is also considered within the decision support tool. Each question is assigned an estimate of certainty by the assessor, and are meant to categorize the level of epistemic uncertainty associated with each assessment. Uncertainty is summed across the categories for each section, and a percentage of uncertainty is calculated for each section. This percentage of uncertainty is provided to show the level of uncertainty associated with the final recommendation. The tool will be calibrated for optimal performance over time as new information is obtained and uncertainty is reduced. This decision support tool can stand alone or be used in concert with other risk assessment tools currently under development, and will fit into a greater framework for early detection and rapid response efforts in the Greater Everglades Ecosystem.

BIO: Dr. Romagosa is a Research Assistant Professor at the University of Florida. Her research focus falls into four overlapping aspects of biological invasions: process through the influence of wildlife trade, prevention through risk assessment, ecological impacts, and policy and management.

Contact Information: Christina M. Romagosa, Department of Wildlife Ecology and Conservation, University of Florida, PO Box 110430, Gainesville, FL, USA 32611, Phone: 352-273-3996, Email: cmromagosa@ufl.edu

MANAGING MULTIPLE SPECIES WITH CONFLICTING NEEDS IN THE EVERGLADES

***Stephanie S. Romañach**[1], James M. Beerens[1], and Leonard G. Pearlstine[2]*
[1]US Geological Survey, Fort Lauderdale, FL, USA
[2]Everglades National Park, Homestead, FL, USA

Conservation planning focused on a single species can have benefits for additional species with shared habitat requirements; however, in many cases, a single-species focus ignores the needs of other species in the ecosystem. In the Everglades, federal and state agencies have undergone enormous efforts to conserve key species in this wetland ecosystem. Although native species in the Everglades rely on a wetland environment, these species can differ in their habitat preferences. Some species require lower water depths than others during the wet season to breed or find food, and others may require minimal fluctuations in water depth through the wet season. The Everglades is a highly-managed ecosystem, and managing to achieve optimal conditions for all species of concern is a challenging task.

Decision analysis offers a formalized method to identify natural resource management objectives, develop alternative management actions to meet those objectives, learn from the outcome of implementing actions, and adjust future management actions as a result. Natural resource management objectives can be a function of agency or organizational missions and priorities, and are developed through engagement with stakeholders. Decision analysis can handle multiple, even conflicting objectives, which can result from differing organizational missions among stakeholders. Proposed natural resource management actions are then evaluated for their potential to achieve identified objectives.

Implementation of decision analysis is on the rise in natural resource management, for example, in examining optimal control strategies for invasive species and in conservation planning for endangered species. These methods are well-suited for application to multi-species conservation planning in the Everglades. Historically, natural resource management actions in the Everglades have focused on one species at a time given the often conflicting hydrologic preferences of the suite of species of concern. We are developing a spatially-explicit tool that runs species distribution models with forecasts of probabilistic water depths to allow managers to examine optimal allocations of water across the Everglades, even for species with conflicting needs. Our approach can be used across the Greater Everglades landscape or in project-specific areas.

BIO: Stephanie is a Research Ecologist at the USGS Wetland and Aquatic Research Center. She uses a combination of field observations and predictive ecological models to explore the impacts of climate change and ecosystem restoration on wildlife. The results of her work are used in the Everglades restoration decision making process.

Contact Information: Stephanie S. Romañach, US Geological Survey, 3321 College Ave, Fort Lauderdale, FL, USA 33314,
Phone: 954-377-5921, Email: sromanach@usgs.gov

WHY THE PRIMARY PRODUCERS (ALGAE AND CYANOBACTERIA) ARE THE KEY EARLY RESPONDERS TO NUTRIENT AND WATER FLOW CHANGES IN THE EVERGLADES

Barry H. Rosen[1], *Sue Newman*[2], *Joel Trexler*[3], *Sarah Bornhoeft*[3], *Eric Tate-Bolt*[2] *and Colin Saunders*[2]
[1]United States Geological Survey, Orlando, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA
[3]Florida International University, North Miami, FL USA

The base of the food-web in the Everglades includes a vast array of photosynthetic organisms. Bacillariophyceae (diatoms), Cyanobacteria (blue-greens), and Chlorophyta (green algae) are the most abundant primary producers; however, the community also consists of Cryptophyta (cryptomonds), Chrysophyceae (golden-brown algae), Pyrrhophyta (dinoflagellates) and Euglenophyta (euglenoids). These organisms form periphyton mats, colonize the stems and leaves of aquatic plants and live planktonically in sloughs, sawgrass marshes, and canals. As photosynthetic organisms, they rely on sunlight as an energy source and utilize carbon (as carbon dioxide or bicarbonate) and inorganic nutrients for growth and reproduction, and certain cyanobacteria are also able to fix atmospheric nitrogen.

In the oligotrophic portions of the Everglades, the dominant organisms in the periphytic community are adapted to low nutrient conditions, with a few species of diatoms and cyanobacteria being the most abundant. The community in these oligotrophic habitats also have rare members – just one or more individuals amongst the tens of thousands of the dominant organisms. These rare members may exist in alternate morphological states such as normal versus resting stages, but are still viable. For example, the filamentous green algae, both *Spirogyra* and *Mougeotia*, are found in these oligotrophic habitats as single or two-celled filaments. In more nutrient-rich waters, these organisms form multi-cellular filaments that are many millimeters in length. Following a perturbation, such as the introduction of flow and/or nutrients in the in the Everglades adaptive management efforts we observed rare or morphologically reduced organisms increased in abundance and size, which altered community measures such as species richness. Green algae were particularly responsive; single-celled and colonial forms infrequently encountered under oligotrophic conditions reproduce and become more common when nutrients and flow increase. By contrast, the oligotrophic Cyanobacteria are diminished and revert to being a rare member of the community.

The dynamic nature of the algal and cyanobacterial community, with its diversity of organisms that readily respond to changing conditions, allows certain members of the community to thrive while others retreat. These changes in the community structure and associated nutritional value also have implications for the Everglades primary consumers.

BIO: Dr. Rosen is an algal physiologist, with emphasis on the ecophysiology of organisms in a variety of habitats, especially the Everglades. He is documenting the microscopic organisms that he encounters: Catalog of microscopic organisms of the Everglades, Part 1—The cyanobacteria: U.S.G.S. Open-File Report 2016 –1114, 108 p., http://dx.doi.org/10.3133/ofr20161114

Contact Information: Barry H. Rosen, USGS SE Region, 12703 Research Parkway, Orlando, FL, USA 32826, Phone: 407-803-5508, Email: brosen@usgs.gov

STRUCTURE AND RECENT DYNAMICS IN COASTAL EVERGLADES TREE ISLANDS

Michael Ross, *Susana Stoffella, Rosario Vidales, Himadri Biswas, Keqi Zhang, and John Meeder*
Florida International University, Miami, FL USA

Tree islands are a familiar feature in the freshwater Everglades, but in the Southeast Saline Everglades, where they are easily recognized as teardrop shapes on coastal imagery, their dynamics have not been completely described. In 1994-95, we first explored the tree islands in this remote coastal region, along with the marshes and swamps in which they were embedded, and in 2016-2017 we resampled both elements of the landscape. In this presentation, we discuss the structure and dynamics of the tree islands, addressing specifically whether changes in these forested patches paralleled those in the surrounding wetland matrix, which has experienced a rapid transformation from marsh to dwarf mangrove swamp. We assessed the change in woody species composition over the period, and characterized the soils, physiography, and hydrologic regime of each island. Typically, tree island surfaces were ~30 cm above the adjacent marsh, allowing fresh water to be recharged and retained. Soil profiles were variable, but organic sediments predominated, in contrast to the marl soils in the surrounding wetlands. Paralleling their invasion of the adjacent marsh, mangrove species, especially *Rhizophora mangle*, had become an important element in the tree canopy of nearly all islands during the 22 years between surveys, but glycophytes more often found in well-drained sites (e.g., *Metopium toxiferum, Calyptranthes pallens, Swietenia mahogani*) have persisted. In the exposed settings they occupy, tree islands are highly vulnerable to sea level rise and storm impacts, but over the last few decades – a period in which the area we studied avoided major disturbances - they have proved quite resilient, and continue to represent important centers of biodiversity in the coastal landscape.

BIO: Dr. Ross is a plant community ecologist in the FIU's Department of Earth and Environment, and a long-time associate in the Southeast Environmental Research Center. Since 1988, his research has targeted ecological and management questions of the forest and wetland landscapes of the Florida Keys, Everglades, and urbanized Miami-Dade County.

Contact Information: Michael Ross, FIU/MMC; SERC/OE148; Miami, FL, USA 33199, Phone: 305-348-1420, Email: rossm@fiu.edu

INTEGRATION AND REFINEMENT OF EVERGLADES SCIENCE: NEW CONCEPTUAL MODELS AND ANALYSIS OF ECOLOGICAL VULNERABILITY

David Rudnick[1], *Jed Redwine*[1], *Agnes McLean*[1], *Patti Gorman*[2], *Fred Sklar*[2], *Gretchen Ehlinger*[3], *Kelly Keefe*[3], *Melissa Nasuti*[3], *Jenna May*[3]

[1]South Florida Natural Resources Center, Everglades National Park, Homestead, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL., USA
[3]US Army Corps of Engineers, Jacksonville, FL, USA

The development of conceptual ecological models (CEMs) about fifteen years ago (see articles in *Wetlands* volume 5, no. 4, 2005) by scientists who helped establish the REstoration, COordination and VERification (RECOVER) program provided a foundation for understanding the state and dynamics of the Everglades ecosystem and for Everglades Restoration. The role of RECOVER, which is part of the Comprehensive Everglades Restoration Plan (CERP), is to inform CERP planning and implementation to promote restoration success. The CEMs informed the development of restoration performance measures and the design of the RECOVER Monitoring and Assessment Plan (MAP), including MAP Hypothesis Clusters. Via these efforts and their linkage to an adaptive management process, RECOVER has guided and spurred Everglades Restoration project planning, sequencing and restoration progress.

Over the past 15 years, we have increased understanding of the Everglades ecosystem and its vulnerability to well recognized drivers of stress – historic water diversions and nutrient loading from the Everglades' developed boundary. We also have increased understanding and awareness that the impacts of other drivers, especially climate change, sea-level rise, and exotic invasive species, are accelerating and altering the Everglades and how the system responds to restoration actions. In order to better integrate and incorporate new scientific knowledge into restoration planning and assessment across the entire greater Everglades system, RECOVER has initiated an effort to update the CEMs, including sub-regional models and a total-system model, and MAP Hypothesis Clusters. Also, based on our recognition of these accelerating threats, RECOVER has initiated an ecological vulnerability analysis to identify areas, species, habitats, and processes that are most vulnerable to known stressors. This analysis will further our ability to identify and prioritize restoration needs and guide restoration actions to minimize this vulnerability. The combined effort of updating CEMs and hypotheses, and analyzing vulnerability is expected to help refine restoration performance measures, focus future monitoring and assessment, and inform our adaptive management process, which will enhance the ability of Everglades Restoration programs and projects to restore and sustain the Greater Everglades Ecosystem.

BIO: Dr. Rudnick is an estuarine and wetland ecologist and the Science Coordinator for Everglades National Park. He is responsible for the planning, oversight, and synthesis of monitoring, research, and modeling that supports Everglades restoration and Park management. His past research has focused on understanding Florida Bay – Everglades watershed linkages.

Contact Information: David Rudnick, South Florida Natural Resources Center, Everglades National Park, 950 N. Krome Ave, Homestead, FL 33030, USA. Phone: 305-224-4245, email: david_rudnick@nps.gov

ECOLOGICAL MONITORING TO TRACK SUCCESSION AND EVALUATE PERFORMANCE OF A WESTERN EVERGLADES MITIGATION BANK

Shawn Clem and ***Mica Rumbach***
Western Everglades Research Center, Audubon Florida, Naples, FL, USA

Loss of native habitats due to agriculture, mining, and residential and commercial development is a growing problem throughout the Western Everglades. Habitat loss is a primary concern for wildlife, particularly species of concern like the Florida Panther (*Puma concolor coryi*) and the Wood Stork (*Mycteria americana*) that rely on the characteristic habitat mosaic. With the large acreage of undeveloped land in Collier and Lee counties in private ownership science-based conservation and restoration are an imperative focus.

Panther Island Mitigation Bank is a 4,471-acre property owned by Audubon Florida and located directly adjacent to Audubon's Corkscrew Swamp Sanctuary. Formerly row crops, restoration of this property (top soil preservation, land contouring and grading, native species planting, invasive and exotic plant species management and prescribed burning) began in 1999 and is being conducted in phases by Florida Wetlandsbank LLC. We began an ecological monitoring program in 2013 in advance of the restoration of three additional phases of short- to intermediate-hydroperiod wetlands interspersed with hydric and mesic pine and cypress. Our monitoring program was designed to document change from fallow fields, through the restoration process, and through post-restoration succession. Monitoring is also conducted on previously-restored phases of the bank and at reference sites within Corkscrew Swamp Sanctuary.

Monitoring components and protocols were designed primarily to evaluate the value of the bank for wading birds. These components include hydrology (groundwater and rainfall), vegetation (trees, shrubs and herbaceous), aquatic fauna (fish and macroinvertebrates) and wading birds. Additionally, songbird and mammal monitoring components were added to provide additional information on the value of the restored habitat for wildlife. We describe our monitoring program and present preliminary data. We discuss the importance of a science-based approach to wetland mitigation and the need for continued monitoring and adaptive feedback during and following restoration.

<u>BIO</u>: Mica Rumbach is the field technician for the Western Everglades Research Center at Corkscrew Swamp Sanctuary. She received a B.S. in Animal Ecology from Iowa State University and assisted with ecological field research in Idaho, Alberta (Can.) and Louisiana before beginning her work in the Western Everglades in 2014.

<u>Contact Information</u>: Mica Rumbach, Corkscrew Swamp Sanctuary, 375 Sanctuary Road West, Naples, FL, USA 34120,
Phone: 239-354-4469, Email: mrumbach@audubon.org

A FORMAL CAUSAL ANALYSIS OF DRIVERS RESPONSIBLE FOR GEOGRAPHIC AND TEMPORAL VARIABILITY IN MERCURY BIOMAGNIFICATION ACROSS THE EVERGLADES

Darren G. Rumbold
Florida Gulf Coast University, Ft. Myers, FL, USA

Numerous theories were put forward following the discovery of high mercury (Hg) levels in Everglades' biota to account for the system's susceptibility and for the geographic variation in biomagnification. Based on the results of early studies and the contemporaneous discovery of widespread sulfate contamination, a consensus emerged that while a high rate of atmospheric Hg deposition was the principal cause of the problem, the susceptibility was due to sulfate stimulation of methylmercury (MeHg) production across the Everglades. Moreover, it was the balance between sulfate stimulation and sulfide inhibition of methylation that was the driver of the geographic and temporal variability. This became the prevailing paradigm. Recently FDEP/SFWMD have, however, offered several alternative candidate causes for the susceptibility and geographic variability, including the possibility that microbes other than sulfate-reducing bacteria may be responsible for Hg methylation; that water quality parameters, other than sulfate, may have more influence in the accumulation of MeHg; or that food web dynamics and habitat influences hotspot locations.

The objective of this analysis was to re-examine the cause of the variability in biomagnification using a formal causal analysis. This analysis was based on the framework developed by USEPA as part of a causal analysis/diagnosis decision information system for exploring causation (http://www.epa.gov/ caddis). This guidance recognizes that establishing causality is neither simple nor straightforward. It recommends the use of expert judgment applied in a consistent and transparent manner and which is based on the totality of evidence, of which the result of any single study is only a component. Accordingly, this analysis summarizes many different types of evidence from both the Everglades and from other systems stemming from: 1) controlled laboratory experiments, 2) laboratory tests of media collected from the field, 3) field studies assessing spatial and temporal gradients, 4) manipulative experiments using mesocosms and, 5) stressor-response relationships from ecological simulation models. Although a few studies presented here purport to refute this cause, as discussed herein, these lines of evidence were weakened for a variety of reasons. The consistency of the evidence from the Everglades in combination with the consistency of association outside of Florida convincingly supports the case for sulfate. This analysis further suggests that the poor predictive capabilities of existing statistical models was due to a mismatch in measurement scales with transient events being missed (e.g., using average surface water sulfate collected on a quarterly basis, as a proxy for highly variable, redox dependent porewater sulfide, to assess MeHg availability, which can vary diurnally). If we are truly committed to improving the predictive capabilities of our statistical models to allow us to develop and implement strategies to control the Everglades' Hg problem, then we must develop new and improved technologies for measuring these processes at appropriate spatial and temporal scales.

BIO: Dr. Rumbold began working on mercury in 1989 when he initiated a biomonitoring program adjacent to a solid-waste incinerator. He later served as Senior- then Lead Scientist with SFWMD before joining the faculty of FGCU in 2006, where he is now a Professor teaching courses in ecotoxicology and risk assessment.

Contact Information: Darren Rumbold, Florida Gulf Coast University, 10501 FGCU Blvd. South, Fort Myers, FL 33965,
Phone: 239. 590.7527. Email: drumbold@fgcu.edu

A REGIONAL-SCALE ECOLOGICAL RISK ASSESSMENT OF MERCURY ACROSS SOUTH FLORIDA

Darren G. Rumbold
Florida Gulf Coast University, Ft. Myers, FL, USA

A regional-scale risk assessment is a complex multidimensional problem that must consider an ecological entity moving across the landscape experiencing varying concentrations of the toxicant over differing exposure periods. In most regional-scale assessments, exposure typically occurs over extended periods of time at relatively low concentrations with the animal moving through a limited number of areas containing high concentrations for only short periods. In the Everglades, mercury (Hg) is widely distributed in prey items across the landscape however, as evidenced by the areal extent where levels in mosquitofish and sunfish exceed an established criterion for protection of wildlife. Subject to species-specific (and ontogenetic-specific) trophic positon - diet, capability to clear the toxicant (through pathways such as feathers or fur), growth rate, foraging range and physiological sensitivity to the toxicant, ecological entities may manifest an array of different effects. Depending on exposure, different proportions of a population may show some type of binary effect (e.g., live versus dead) while others may exhibit varying severities of a continuous response (e.g., degree of altered neurochemistry, behavior or histopathology). In some cases, these effects can lead to death but, more often, to reduced fitness leaving the entity at a competitive disadvantage (i.e., unable to find food), at an increased risk of predation or with some reproductive impairment. This “ecological mortality” can be the answer to the often-posed question “if the problem is so bad, where are all the dead bodies?”

To avoid uncertainty inherent in estimating exposure using data-intensive, spatially-explicit models, this assessment summarizes available data on tissue-Hg concentrations in fish and wildlife (e.g., osprey, Great egrets, and panthers), mindful of their spatial characteristics, and compares them to toxicity reference values (TRVs) from the published literature, in this case critical tissue concentrations. This risk analysis clearly shows that biological hotspots (i.e., localized areas where biota exhibit elevated Hg levels as compared to the surrounding landscape and in excess of established criteria for protection of human or wildlife health) remain in south Florida. However, TRVs are lacking for many potential sublethal responses reported from Hg exposure, especially altered behavior. Without improved estimates of the frequency of these sublethal responses and probability of ecological mortality, risks may go underappreciated by resource managers who may view the uncertainty as justification for taking no action. If we are truly committed to reducing this uncertainty in support of decision-making, it is recommended that Everglades’ wildlife biomonitoring programs be augmented in the future to include recently recommended biomarkers of effect (e.g., measures of various neurochemicals, glucocorticoids, thyroid hormones, fluctuating asymmetry, histology, etc.).

BIO: Dr. Rumbold began working on mercury in 1989 when he initiated a biomonitoring program adjacent to a solid-waste incinerator. He later served as Senior- then Lead Scientist with SFWMD before joining the faculty of FGCU in 2006, where he is now a Professor teaching courses in ecotoxicology and risk assessment.

Contact Information: Darren Rumbold, Florida Gulf Coast University, 10501 FGCU Blvd. South, Fort Myers, FL 33965, Phone: 239. 590.7527. Email: drumbold@fgcu.edu

SOMEONE HAS TO WATCH THE CRABGRASS GROW: A SURVEY OF POTENTIAL EFFECTS OF HYDROLOGIC RESTORATION ON MARL PRAIRIE PLANT SPECIES

Jimi Sadle
National Park Service, Everglades and Dry Tortugas National Parks, Homestead, FL, USA

Everglades National Park is well known for a number of rare species that are or have been found within the boundary of the park. Several of these species are associated with marl prairies of Long Pine Key as well as short hydroperiod rocky glades in the East Everglades Expansion Area. Recently, structural and operational changes aimed at improving hydrologic conditions in Taylor Slough and Florida Bay have been implemented or are planned for the near future. At a minimum, understanding the impacts of these changes to all imperiled species is essential to ensuring that affects to these species, if they occur, are documented. The purpose of this presentation is to provide an overview of rare plant and insect species that occur in marl prairies of Long Pine Key as well as plant species found in the rocky glades of the East Everglades Expansion area. By using examples, this presentation will explain why these species represent sensitive and underutilized indicators of restoration outcomes, provide an overview of ongoing efforts to track changes in their populations and describe additional direction for needed research or monitoring to ensure that these taxa are adequately considered in planning and implementation of water delivery changes that affect marl prairies in eastern Everglades National Park.

BIO: Mr. Sadle is a Supervisory Botanist at Everglades and Dry Tortugas National Parks. He has more than 15 years of experience working in South Florida conservation areas. His interests include tracking the status and distribution of imperiled plant species.

Contact Information: Jimi Sadle, Everglades and Dry Tortugas National Parks, 40001 SR 9336, Homestead, FL, USA 33034,
Phone: 305-242-7806, Email: Jimi_sadle@nps.gov

MARL PRAIRIE LANDSCAPE AS THE CAPE SABLE SEASIDE SPARROW HABITAT: THE PIVOT OF HYDROLOGIC RESTORATION IN SOUTHERN EVERGLADES

***Jay P. Sah*[1]**, *Michael S. Ross*[1, 2], *James R. Snyder*[3], *Susana Stoffella*[1], *Pablo L. Ruiz*[4]

[1]Southeast Environmental Research Center, Florida International University, Miami, FL, USA
[2]Department of Earth and Environment, Florida International University, Miami, FL, USA
[3] Naples, FL, USA
[4] South Florida/Caribbean I&M Network, National Park Service, Palmetto Bay, FL, USA

The marl prairie landscape is the habitat of Cape Sable seaside sparrow (CSSS), a federally listed endangered species, which has been a pivot point for water management operations in the Everglades for two decades. The marl prairies, present on both flanks of the Shark River and Taylor Sloughs, have gone through many transitions in hydrologic and fire regime due to management-induced changes in water flow pattern in the southern Everglades. Such changes in habitat conditions during the 1990s resulted in a precipitous decline in sparrow population in four of six sub-populations. Since then, several restrictive measures as well as hydrologic restoration activities have been undertaken to ensure that there is no further damage to sparrow habitat, and to improve the habitat conditions on both sides of the Sloughs. With a goal of understanding the response of landscape-level processes to hydrological restoration, we studied spatio-temporal variation in vegetation structure and composition throughout the marl prairie landscape.

Results showed that vegetation change patterns within the marl prairie landscape varied spatially, primarily responding to variable hydrology and its interaction with fire events. East of the Shark Slough, vegetation in sub-population F and the southwestern edges of sub-populations B and E was indicative of slightly wetter conditions. West of the Shark Slough, the vegetation in the eastern part of sub-population A showed a drying trend, while vegetation in the south and southwestern portion reflected wetter conditions in recent years than early 2000s. In agreement with the trend of vegetation change observed in our study, especially in the eastern part of subpopulation A, recent modeling associated with Everglades Restoration Transition Project (ERTP) and Central Everglades Planning Project (CEPP) has shown some areas that might provide suitable habitat in the future. To address this possibility, our presentation will also include preliminary results from a recent assessment of vegetation status east of sub-population A, and its suitability as sparrow habitat. Our study has implications for Everglades restoration success in the marl prairie landscape where sparrow habitat conditions were damaged by past water management activities.

BIO: Dr. Jay Sah is a vegetation ecologist with three decades of experience in studying plant communities of which 15 years are in the Everglades. Dr. Sah has extensively studied vegetation responses to changes in hydrologic and fire regimes in the marl prairie landscape.

Contact Information: Dr. Jay P. Sah, Southeast Environmental Research Center, Florida International University, OE-148 University Park, Miami, FL 33199, USA. Tel: 305-348-1658 Fax: 305-348-4096 Email: sahj@fiu.edu

INTEGRATION OF FISHERY-DEPENDENT DATA AND LOCAL-ECOLOGICAL KNOWLEDGE TO CHARACTERIZE BONEFISH *ALBULA VULPES* POPULATION TRENDS IN FLORIDA BAY

Rolando O. Santos*, Emily Kroloff, and Jennifer S. Rehage*
Florida International University, Miami, FL, USA

There is a general notation that recreational fishing, especially catch-and-release practices, is not detrimental to fish populations and the environment in comparison to commercial fishing; however, over the last decade, there has been recognition that recreational fisheries could induce stock depletion. Frequently, recreational fisheries are data-poor which restrain the effectiveness of catch trends, stock and harvest assessments. Fisheries-dependent data (FDD) obtained from logbooks, sale slips, and interviews, and local ecological knowledge (LEK) gathered from key stakeholders are two sources of data that could be useful to assess changes and vulnerability of data-poor recreational fishery species. This study was designed to assess the nature of the temporal trend (i.e., gradual vs punctuated decline) in bonefish (*Albula vulpes*) abundance in Florida Bay, a recreational fishery economically important for the region, using a combination of FDD and LEK analyses. Both FDD and LEK assessments pointed to the decline in bonefishing in Florida since the early 1980s, as well as, an accelerated decline that started since the late 90s-early 2000s that resulted in an overall 42% and 60% reduction in catch and perceived bonefishing quality. Trends in the probability of a positive trip and the catching success when bonefish was targeted in guided trips generally followed the trends in catch, suggesting major population changes starting in 1999-2000. The reconstruction of these trends in conjunction with a time-series of disturbances and fishing effort allowed for the development of hypotheses about possible mechanisms behind the decline of bonefish abundance in Florida Bay.

BIO: Dr. Rolando O. Santos is a seascape ecologist and postdoctoral research associate at Florida International University. His research focuses on the restoration and resilience of marine habitats and faunal responses to multi-scale habitat characteristics. Research interests center on the application of landscape ecology concepts in marine ecosystems to study the influence of spatial structure and habitat heterogeneity on the patterning of marine communities, and species interactions, distribution, and movement.

Contact Information: RO Santos, Florida International University, 11200 SW 8th St., Miami, FL, USA 33199, Phone: 304-348-3095, Email: rsantosc@fiu.edu

FLOW IMPACTS ON P AND ORGANIC MATTER CYCLING IN THE RIDGE AND SLOUGH: LESSONS FROM LANDSCAPE BUDGETS IN THE DECOMP PHYSICAL MODEL AND SHARK SLOUGH, ENP

Colin Saunders[1], *Sue Newman*[1], *Erik Tate-Boldt*[1], *Rudolf Jaffé*[2], *Peter Regier*[2], *Barry H. Rosen*[4], *Laurel Larsen*[3], *Jud Harvey*[4], *Eric Cline*[1], *Christa Zweig*[1], *Jay Choi*[4], *Michael Manna*[1], *Chris Hansen*[1,2], *David Ho*[5], *Fred Sklar*[1]

[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]Florida International University, Miami, FL, USA
[3]University of California at Berkeley, Berkeley, FL, USA
[4]US Geological Survey, Orlando, FL, USA
[5]University of Hawaii, Honolulu, HI, USA

A critical component of future Everglades restoration projects includes the restoration of sheetflow. The Decomp Physical Model (DPM), a landscape-scale (2-km x 5-km) field test, has recently shown that restored flows enhance sediment transport, a critical mechanism to restore ridge-and-slough topography and as large-scale landscape models had predicted. The DPM also demonstrated strong biological response mechanisms and associated feedbacks with flow that were not anticipated by models. In three flow events, loss of widespread, floating periphyton was observed in sloughs experiencing high velocities (2-5 cm/s). Slough velocities often increased with flow duration, suggesting an important mechanism in enhancing flow through reduced vegetative resistance. Furthermore, the erodibility of benthic flocculent sediments (“floc”) and the source of floc (more green algae-derived, less cyanobacteria-derived) also changed with flow duration and season. We hypothesize biological responses to flow may be as or more important than physical mechanisms regulating sediments in sloughs and ridges. We address this hypothesis by using an ecosystem mass-balance model to identify the primary mechanisms controlling stocks and fluxes of sediment and Phosphorus (P) under high and low flows. The model – originally developed for central Shark Slough, Everglades National Park - was adapted to the DPM study area and simulated for multiple scenarios, assuming different combinations of biological and physical responses to flow. By comparing model scenarios against DPM observations, our preliminary findings indicate that including both physical and biological responses to flow provided the best fit to observed changes in water column P and sediment, sediment transport, and floc standing stocks. We discuss how these flow responses may transform ecosystem sediment and P cycling changes downstream, such as observed in DPM and pertinent to the freshwater-mangrove ecotone in Shark Slough.

BIO: Dr. Saunders is a Lead Scientist in the Everglades Systems Assessment section of the SFWMD and currently serves as team lead of the interagency science team for the Decomp Physical Model, a field test evaluating sheetflow benefits in Water Conservation Area 3B.

Contact Information: Colin Saunders, Everglades Systems Assessment Section, South Florida Water Management District, 8894 Belvedere Road, West Palm Beach, FL, USA 33411, Phone:561-753-2400 ext. 4644, Email:CSaunder@sfwmd.gov

SHIFTING BASELINES IN SOUTHWEST FLORIDA'S OYSTER POPULATIONS: THE EFFECTS OF OVERHARVESTING BY NATIVE AMERICANS AND THE IMPLICATIONS FOR FUTURE MANAGEMENT AND RESTORATION OF OYSTER REEFS

***Michael Savarese*[1]**, *Shanna Stingu*[1], *Karen Walker*[2], *William Marquardt*[2] *and Victor Thompson*[3]
[1]Florida Gulf Coast University, Ft. Myers, FL, USA
[2]Florida Museum of Natural History, University of Florida, Gainesville, FL, USA
[3]University of Georgia, Athens, GA, USA

Oyster reefs in Southwest Florida (USA) have been integral to estuarine ecology throughout the Holocene. Though *Crassostrea virginica* has never been commercially harvested, aboriginal people used the oyster substantially, accumulating middens between 5000 BC and AD 1700. A conservation paleobiological / historical ecological study of oysters from middens and modern reefs within Estero Bay (EB) and Pine Island Sound (PIS) determined if oyster productivity changed due to aboriginal overharvesting. Archaeological samples came from sites including the Late Archaic (LA, 2000-500 BC) of PIS and the Caloosahatchee (Cal, 500 BC-AD 1500) of EB and PIS. These samples were compared with natural oyster death assemblages from neighboring modern reefs. Methods comprised measuring oyster convex valve lengths and sectioning shells to count ligament pit growth lines that served as proxy for growth rate. The biologic taphonomic grade was also compared after scoring the interior valve surface; biologic grade is near pristine for oysters collected live for consumption. Archaeological samples exhibit significantly better taphonomic grades when compared to modern assemblages, confirming the hypothesis that oysters were harvested for food. Valve length decreased significantly from LA to Cal time, whereas modern assemblages were indistinguishable from LA collections. Because the Cal samples span 4 climatic intervals, the results suggest that climate change was not responsible for shifts in productivity.

Results support the hypothesis of overharvesting during Cal times. They also suggest that modern oysters retain the capacity for growth, and indicate that aboriginal activity did not result in a permanent microevolutionary shift. Estuarine managers, particularly those designing and implementing oyster reef restoration projects in Southwest Florida's estuaries should be reassured by these results. Although aboriginal people did cause a shift in oyster population structure, the current stock of *C. virginica* retains the same growth potential as seen in the LA, before overharvesting began. Seeding reefs with locally grown oysters or through natural recruitment ensures the potential for oyster productivity. Finally, these results are also relevant for the ongoing discussion surrounding the creation of an Anthropocene Epoch; the shell middens built throughout history greatly influenced both estuarine ecology and landscapes through fishing and engineering practices.

BIO: Dr. Savarese is a Professor of Marine Science with 25 years of experience teaching at the university level and conducting research in coastal estuarine settings. His expertise lies in conservation paleobiology, historical ecology, and coastal geomorphology. His work makes strong connections to efforts concerning Greater Everglades' restoration.

Contact Information: Michael Savarese, Department of Marine & Ecological Sciences, 10501 FGCU Blvd. South, Florida Gulf Coast University, Ft. Myers, FL, USA 33965, Phone: 239-590-7165, Email: msavares@fgcu.edu

THE EVERGLADES REMAP PROGRAM: THREE DECADES OF LANDSCAPE ASSESSMENT FOR CRITICAL ECOSYSTEM INDICATORS

***Daniel J. Scheidt*[1]**, *Peter Kalla*[1], *Jennifer Richards*[2], *Daniel Gann*[2], *Leonard Scinto*[2], *Yong Cai*[2] *and Guangliang Li*[2]
[1]United States Environmental Protection Agency, Athens, GA, USA
[2]Florida International University, Miami, FL, USA

USEPA has been conducting a landscape assessment of the Everglades' health over the last 20 years. The Regional Environmental Monitoring and Assessment Program, or REMAP, measures conditions for water quality and ecological resources over space and time. This program is the only scientific effort in the Everglades that combines: a stratified random approach which permits quantitative statements about ecosystem health across the Everglades; and an extensive 2000 square mile coverage that includes all of the Everglades and many media (water, soil, fish, periphyton, and plants such as sawgrass and cattail). The probability-based design makes possible quantitative statements across space about the condition of the ecosystem, allowing statements such as in 2005 49 +/- 7 % of the Everglades had a soil phosphorus concentration greater than the restoration goal of 400 mg/kg, as compared to 34 +/- 5% in 1995-96. During phase I (1993-1996), phase II (1999), phase III (2005), and phase IV (2013-2014), USEPA sampled 1000 marsh locations. Biogeochemistry is sampled at about 120 locations in a two-week window in order to assess the entire Everglades flow-way at a point in time. The Project has necessitated advances in field sampling and analytical methods. The Program also has documented plant community distribution and aquatic food webs.

Through the years Everglades REMAP data have been used by the National Academies of Sciences and about 30 Federal or Florida agencies, Indian tribes, environmental groups, agricultural interests and universities. Program data address key Everglades protection and restoration issues including water management and soil loss, as well as tracking the effectiveness of efforts to control phosphorus and mercury and to restore Everglades habitat. Program data have been used to better understand a wide range of restoration issues: mercury hot spots and factors associated with mercury bioaccumulation; mercury cycling, distribution and mass balances; mercury deposition limit modeling; sulfur distribution; water conditions; soil thickness, characteristics, nutrients, carbon pools, and subsidence; periphyton mats and consumer community structure; and vegetation classes and distribution. Program investigators have authored about 30 journal publications or scientific agency reports, which have been cited over 800 times. All program data are available to the public through EPA's web site: https://www.epa.gov/everglades/environmental-monitoring-everglades

This collaborative effort has been made possible by funding support from USEPA, Everglades National Park, the Army Corps of Engineers, and the Florida Department of Environmental Protection; helicopter operations support from Everglades National Park and the Arthur R. Marshall Loxahatchee National Wildlife Refuge; sampling consent from the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Indians; and Program investigators at Florida International University.

BIO: Mr. Scheidt is a senior scientist on Everglades water quality, advising managers regarding various scientific, regulatory or policy matters. He began working in the Everglades in 1982, and has been the Associate Program Manager for the REMAP Program since 1992. He is an author on about 60 technical reports.

Contact Information: Daniel J. Scheidt, USEPA Region 4 Water Protection Division, 980 College Station Road, Athens, GA 30605, Phone: 706-355-8724, Email: scheidt.dan@epa.gov

DEVELOPMENT OF ENVIRONMENTAL DNA PROBE FOR EARLY DETECTION OF BULLSEYE SNAKEHEAD CHANNA MARULIUS

***Pamela J. Schofield*[1]*, Mohammad Jubair*[2]**, *Mary Brown*[1], *Margaret Hunter*[1]
[1]US Geological Survey, Gainesville FL, USA
[2]Cherokee Nation Technologies, Gainesville FL, USA

Bullseye snakehead *Channa marulius* was first collected in Tamarac, Florida in 2000. It is native to Asia (India, China, and throughout Southeast Asia) and may have been introduced via the aquarium trade or live-food market. The species is of concern to natural resource managers because it is a fast-growing predator that may reach a large size (1.8 meters, 30 kilos). Since the initial population was discovered, it has spread to cover more than 900 km^2. Until now, the snakehead population has primarily infested residential canals and ponds; however, as it expands across south Florida it threatens to invade more natural areas such as the Water Conservation Areas, Loxahatchee National Wildlife Refuge and Everglades National Park.

We are developing an environmental DNA (eDNA) probe to assist with detection and mapping of snakehead's geographic range. Environmental DNA (eDNA) is increasingly being used for detection of non-native species to inform management actions, such as targeted removal efforts or barriers to movement. Genetic detection methods are time and cost effective in a number of systems and are often preferable to traditional methods for the detection of freshwater fish. Environmental DNA originates from cellular material shed by organisms (via skin, excrement, etc.) into water or soil, and can be used for species identification. We have developed and validated a species-specific assay for use on both quantitative and state-of-the-art digital PCR and have tested water samples with known and unknown populations of snakehead. Environmental DNA will help natural resource managers follow changes in snakehead's range as it expands across south Florida, providing early warning to parks and conservation areas. This project addresses a goal of the USGS invasive species program to provide tools, technology, and information to prevent, contain, control and manage invasive species.

BIO: Dr. Schofield studies various aspects of non-native fish biology and ecology, including their impacts on native fauna. Dr. Jubair investigates invasive species with population genetics and eDNA to characterize invasive pathways.

Contact Information: Pamela Schofield, USGS and Mohammad Jubair, Cherokee Nations; 7920 NW 71st Street, Gainesville, FL 32653; pschofield@usgs.gov; mjubair@usgs.gov

SPATIAL DISTIBUTION IN EVERGLADES NUTRIENT BUDGETS AND THEIR EFFECTS ON BIOGEOCHEMICAL PROCESSES

Leonard J. Scinto[1], *Alexandra Serna*[1], *Diana N. Johnson*[1], *Jennifer H. Richards*[1], *Daniel J. Scheidt*[2] *and Peter Kalla*[2]
[1]Florida International University, Miami, FL, USA
[2]United States Environmental Protection Agency, Athens, GA, USA

The well-documented hydrologic alteration of the Everglades over the 20th century has led to many physicochemical changes and alterations in the patterns of nutrients, contaminants, and carbon at landscape scales (Osborne et al., 2011, Yamashita et al., 2010, Liu et al., 2009). This research is part of the on-going United States Environmental Protection Agency's Everglades Regional Environmental Monitoring Assessment Program (EVR R-EMAP) whose purpose is to synoptically characterize changes in landscape patterns across the Greater Everglades Ecosystem (GEE).

The dynamics of soil C storage and cycling has been a major focus of the USEPA Everglades R-EMAP for several reasons including: the importance of wetlands peat to the global carbon cycle, the loss of Everglades peat due to subsidence, and the implications of restored (increased) hydrology on peat soil preservation and accretion. The respiration of soil organic matter (OM) is dependent on several factors including hydrology, nutrient availability, and the lability of the stored organic matter. It was hypothesized that physicochemical conditions will, at least partially, control the mineralization of organic carbon and OC that may be recalcitrant under a given condition could become labile as conditions change.

To determine the spatial distribution of nutrients and carbon stocks across the GEE the most recent iteration of the larger EVR R-EMAP project (wet season 2014) 119 sites distributed across the GEE were sampled for environmental compartments including Soil, Flocculent detrital organic matter (floc), periphyton, surface water, and vegetation (Sawgrass, *Cladium jamaicense* Crantz) and analyzed for physicochemical parameters. Solid materials were analyzed for bulk density, moisture and ash contents, and total carbon, nitrogen and phosphorus (TC, TN, TP) concentrations. Surface water was analyzed for total and soluble nutrients.

Additionally, twenty five sites were "semi-randomly selected" based on expected soil characteristics, before sampling, to represent each of five "sub eco-regions". There were five "replicate" sites in each of the five areas that represented Northern Peats (Water Conservation Area-1, WCA-1), Impacted Peats (WCA-2), Central Glades (WCA-3), Southern Peats (Shark River Slough in Everglades National Park, ENP), and Marl Soils (ENP short hydroperiod marshes). Fresh soil from these selected sites were assayed to determine the influence of added P and the lability of soil C on soil OM decomposition (measured via CO_2 efflux). Soils were unamended controls or augmented with 0.4 mmole P (KH_2PO_4) g^{-1} dry weight soil or 1.2 mmole C (glucose) g^{-1} dw soil or the combination. Samples were incubated at room temperature in the dark for 24 to96 hours after which the headspace gases were analyzed for CO_2 content. Most soils responded to augmentation but to varying degrees.

<u>BIO</u>: Dr. Leonard J. (Len) Scinto is an associate professor in the Department of Earth and Environment and a research scientist in the Southeast Environmental Research Center at Florida International University. He has been working in the Everglades system for >25y with research focused on the effects of hydrologic and nutrient variation on biogeochemical processes.

<u>Contact Information</u>: Leonard J. Scinto, Ph.D., Department of Earth and Environment AHC5-368, Florida International University, 11200 SW 8th Street, Miami, FL, USA 33199, Phone: 305-348-1965, Email: scintol@fiu.edu

UPDATE ON TRAPPING NILE MONITORS (*VARANUS NILOTICUS*) IN SOUTHEAST FLORIDA

***Nicholas J. Scobel**, Trent R. Adamson, Jennifer Ketterlin Eckles, Michael R. Rochford and Frank J. Mazzotti*
University of Florida, Fort Lauderdale Research and Education Center, Davie, FL

The spread of invasive species throughout the state of Florida poses a wide array of threats to native ecosystems and species. Nonnative species impact local biodiversity and also threaten large-scale restoration initiatives such as the multi-million dollar restoration of the Everglades. The University of Florida (UF) has been involved with multiple projects working on invasive species such as the Burmese Python (*Python molurus bivittatus*), Argentine Black and White Tegu (*Tupinambis merianae*) and Nile Monitor (*Varanus niloticus*). In recent years, Nile Monitors in Palm Beach County have become a pressing issue as they seem to be expanding toward suburban areas and large natural areas such as Arthur C. Marshall Loxahatchee National Wildlife Refuge.

Nile Monitors were first introduced to Florida in the early 1990s, and have since become established in three counties in the southern part of the peninsula; southwestern Florida within the city of Cape Coral area (Lee County), and southeast Florida near Homestead (Miami-Dade County) and along the C-51 canal in Palm Beach County. An essential component of any work associated with invasive species is removal, especially as it pertains to containment and potential eradication. Most removal of Nile Monitors in southeast Florida has been through the use of firearms, however this method presents challenging limiting factors, as monitors inhabit areas close to private residences and public roadways. In addition, removal methods which entail live animals yield useful benefits, such as the potential for radio telemetry to build a better understanding of spatial ecology and habitat use in a suburban landscape. Though there have been successful trapping efforts in southwest Florida, trapping efforts have been less successful in southeast Florida. To address this issue, focused efforts on improving trapping methodology have been carried out by UF in conjunction with the Florida Fish and Wildlife Commission. For this study, we compared trap types, sizes, and baits. Trap arrays were deployed in sets of two or four traps whenever possible, with each set baited with chicken or squid. Traps were checked daily and were opened on Monday morning, and closed on Friday afternoon. Preliminary results are promising, with four Nile Monitors being captured. Of the monitors captured; two were sub-adults and two were large adults. Traps of all sizes and models have been successful, including Havahart 1079 and Tomahawk S50, a custom-built USDA Model, and a modified Havahart (two back-to-back Havahart 1079s).

BIO: Nick Scobel is a wildlife biologist at the University of Florida's Croc Docs lab in Fort Lauderdale, FL. He has more than five years of experience conducting surveys and research on herpetofauna in the eastern United States.

Contact Information: Nicholas Scobel, University of Florida IFAS Fort Lauderdale Research & Education Center, 3205 College Ave, Davie, FL, USA 33314. Phone: 954-577-6304, Email: Nicholas.j.scobel@gmail.com

RESPONSE TO THE WCA-3A HIGH WATER EMERGENCY FEBRUARY – MAY 2016

Seán P. Sculley Sr.
South Florida Water Management District, West Palm Beach, FL, USA

Shark River Slough in Everglades National Park (ENP) experienced inflows during a 90-day period in February to May 2016 that were on the order of what is expected under full restoration conditions. This occurred because of *El Niño*-induced rainfall during the preceding months warranted emergency operations to lower record high Water Conservation Area 3A levels as rapidly as practicable. ENP received more than one-half million acre-feet of inflow during this period. This presentation summarizes hydrologic and water quality conditions that were monitored in Northeast Shark River Slough south to Florida Bay before, during and after emergency operations, in part under a cooperative agreement between Everglades National Park and South Florida Water Management District. The Water Conservation Area 3A (WCA-3A) and WCA-3B flow-weighted mean total phosphorus outflow concentration during the emergency operations was 8 micrograms per liter (µg/L), significantly lower than the 2007-2015 historical average of 13 µg/L for this time of year. Water levels in Northeast Shark River Slough set seasonal record highs. Bottom vegetation in Barnes Sound and Manatee Bay was unaffected by S-197 releases between December 2015 and May 2016.

<u>BIO</u>: Mr. Sculley is a principal engineer with more than 30 years of water resources engineering experience in south Florida. He manages a five-year monitoring cooperative agreement with ENP and authored the SFWMD publication, "Emergency Operations After-Action Report: High Water Conditions in the South Florida Region February 12 – May 11, 2016.

<u>Contact Information</u>: Seán P. Sculley Sr., South Florida Water Management District, 3301 Gun Club Rd. West Palm Beach, FL 33406, Phone: 561.682.6109, Email: ssculley@sfwmd.gov

SOIL BUILDING PROCESSES IN RE-CREATED EVERGLADES TREE ISLANDS

*Leonard J. Scinto[1], **Alexandra Serna**[1], Diana N. Johnson[1], Andres Rodriguez[1,2], Eric Cline[3], Thomas Dreschel[3], and Fred H. Sklar[3]*

[1]Florida International University, Miami, FL, USA
[2]Everglades Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, FL, USA
[3]South Florida Water Management District (SFWMD), West Palm Beach, FL, USA

Tree islands are ecologically important in the Everglades because they add habitat as well as plant and animal diversity to the surrounding marshes. Hydrologic changes have impacted the soils and the vegetation of the Everglades tree islands. Modifications in the duration, frequency, and depth of inundation of the Everglades' soils have reduced peat accretion and increased oxidation and subsidence of the organic soils. More than 2 m of organic soil has been lost in what is now the Everglades Agricultural Area. The reduction of soil accretion is of considerable concern because of its implications in Everglades' processes.

Several studies have been conducted to define tree island vegetation, hydrologic processes, nutrient limitation, and the relationship between them and the underlying geologic composition of re-constructed tree islands. The tree islands in this study are part of a larger research project that has contributed to determine biomass allocation, litter quality, litter production and decomposition rates at different hydrologic conditions. This study examines how ecosystem processes of biomass, litter production and organic matter (OM) decomposition interact with water depth and flow to alter the formation of tree islands. We hypothesized that soil building would have a positive change of soil elevation at shallower water depth and reduced inundation because it favors OM production.

Soil building processes in re-created Everglades tree islands were evaluated based on simultaneous measurements of vertical accretion from feldspar marker horizons and soil elevation change from Surface Elevation Tables (SET). Measurements were conducted in the Loxahatchee Impoundment Landscape Assessment (LILA) facility (Boynton Beach, Florida, USA), where macrocosms mimic Everglades ridge, slough and tree island landscape structure. Soil vertical accretion and change in elevation were monitored in two types of LILA tree islands with peat or limestone cores and at sites with differing water depths (elevations). Within a tree island, the higher elevations (i.e. shallower water) had higher soil accretion, coinciding with the highest litter production and tree productivity.

Soil accretion rates were greater at tree island higher elevations (0.62 cm yr^{-1}) compared to lower elevations (0.52 cm yr^{-1}) as measured annually from 2009 - 2016. Peat islands at higher elevation had the highest total carbon (TC) content, the lowest bulk density, and the highest accumulation of organic matter (242 g m^{-2} y^{-1}). Despite soil building at higher tree island elevations because of higher OM production, a negative change on soil elevation was observed. This loss of elevation was probably related to groundwater withdrawal and sediment compaction at the center of the tree islands (higher elevation).

<u>BIO</u>: Dr. Serna is a Research Analyst, whose work focuses on the interpretation of biogeochemical analyses in several projects of important environmental settings in the Everglades and the Florida Keys. She is in charge of the soil and hydrology activities of the LILA project funded by the SFWMD to conduct flow experiments.

<u>Contact Information</u>: Alexandra Serna, Ph.D., Southeast Environmental Research Center, Florida International University, 11200 SW 8th Street, Miami, FL, USA 33199, Phone: 305-348-0226, Email: asernasa@fiu.edu

EFFECTS OF INCREASED SALINITY ON MICROBIAL PROCESSING OF CARBON AND NUTRIENTS IN BRACKISH AND FRESHWATER WETLAND SOILS

Shelby M. Servais[1,4], *John S. Kominoski*[1,4], *Carlos Coronado-Molina*[2], *Stephen E. Davis*[3], *Evelyn E. Gaiser*[1,4], *Steve Kelly*[2], *Viviana Mazzei*[1,4], *David Rudnick*[5], *Fabiola Santamaria*[2], *Fred Sklar*[2], *Tiffany Troxler*[1,4], *Benjamin Wilson*[1,4]

[1]Florida International University, Miami, Florida, USA
[2]South Florida Water Management District, West Palm Beach, Florida, USA
[3]Everglades Foundation, Palmetto Bay, Florida, USA
[4]Southeast Environmental Research Center, Miami, Florida, USA
[5]Everglades National Park, Homestead, Florida, USA

Everglades coastal wetlands are exposed to saltwater intrusion from storms and sea-level rise (SLR), leading to uncertainties for the fate of belowground carbon (C) storage. Soil microbial extracellular enzyme activities (EEAs) drive organic matter decomposition, and minor changes in microbial enzyme production can result in large changes in soil C loss. Our objectives were to determine how microbial EEAs and root breakdown rates (k) in freshwater and brackish water peat soils are affected by saltwater intrusion. We hypothesized that prolonged exposure to saltwater would result in increased C loss through changes in microbial EEAs potential that result in increased root k. We also predicted that brackish peat soils would have a lower magnitude response to saltwater intrusion compared to freshwater peat soils because of prior exposure. We simulated episodic saltwater intrusion by monthly *in situ* dosing of wetland chambers (n = 6, 1.2 m diameter) with Instant Ocean®. Control wetland chambers (n = 6) were dosed with ambient site water. We deployed 5 root litterbags at three depths (0-10, 10-20 and 20-30 cm) in brackish and freshwater chambers for 2 years (retrieved after 1, 3, 6 9, 12 and 24 months). After each collection, we analyzed the remaining root material for microbial EEAs, elemental stoichiometry (C:nitrogen:phosphorus) and mass remaining.

Differences in EEAs were mostly attributed to wetland location (freshwater, brackish) and depth, not saltwater addition. Acid phosphatase (AP) activities was the only enzyme that differed between treatments and controls; AP was 1.8 × and 1.6 × higher under control than elevated salinity conditions at the brackish and freshwater sites respectively (P = 0.01). Yet, AP was 2.2 and 1.7 × lower at 10-20 cm (P = 0.04) and 20-30 cm depths (P < 0.01) when comparing brackish to freshwater wetland peat soils. Beta glucosidase activities were lower brackish peat soils by up to 6.3 × compared to freshwater peat soils (P ≤ 0.01 for all depths), and the largest differences were measured from surficial soils. We measured up to 30% root mass loss during the first month of incubation, since then, k has remained relatively similar across collection dates. After 6 months of deployment neither site, treatment, or depth affected root k at any depth (P > 0.05). Further analyses will reveal mechanistic responses of increased seawater salinity on soil C loss in freshwater and brackish wetlands of the Florida Coastal Everglades. Furthermore, this study will help inform management decisions by suggesting best management practices for water management and conservation of coastal resources.

<u>BIO</u>: Shelby Servais is a PhD candidate in Biology at Florida International University. Her research focuses on how sea level rise will affect microbial function in the soil of the Everglades.

<u>Contact Information</u>: Shelby M. Servais, Department of Biological Sciences, Florida International University, 11200 SW 8th Street, Miami, FL 33199 USA. Email: sserv005@fiu.edu

FLOATING AQUATIC VEGETATION SUPPRESSION EFFECTS ON CANAL SEDIMENT PROPERTIES IN SOUTH FLORIDA

***Anne E. Sexton**, Jehangir H. Bhadha, Timothy A. Lang and Samira H. Daroub*
University of Florida, IFAS, Soil and Water Sciences and Everglades Research and Education Center, Belle Glade, FL, USA

A significant portion of phosphorus (P) loads discharged from the Everglades Agricultural Area (EAA) in south Florida is in the form of organic particulates from biological sources during farm drainage events. This study was initiated on four treatment-control farm pairs over a five year period to investigate the role of suppressing floating aquatic vegetation (FAV), such as water lettuce (*Pistia stratiotes*), on the formation of more recalcitrant inorganic P forms in farm canal sediments. Treatment canals implemented aggressive FAV suppression, while control canals operated under normal management practices. It is hypothesized that with FAV suppression, co-precipitation of P with calcium and magnesium (Ca-Mg) into less labile, more recalcitrant minerals is increased due to more light penetrating the water column, while P sorption with iron and aluminum increases with higher dissolved oxygen and redox potential. Phosphorus fractionation was used to measure labile and recalcitrant P pools in the eight farm canal sediments at the 0-2.5 cm depth, as well as particulates exported with drainage water during pumping events. On most farms, sediment residue and Ca-Mg-bound P pools had the highest percent of total P ranging from 23.6 to 73.4% for Ca-Mg-bound and 6.1 to 63.6% residue P, while labile P had the lowest between 0.5 to 5.5%. In the discharged particulates, Ca-Mg-bound-P had the highest percentage (28.2 to 61.0%) and labile P was the lowest (0.9 to 19.1%). While labile P was the smallest pool, it was higher in the discharged particulates than canal sediments. The generation of denser inorganic mineral P may reduce P transport out of farm canals and reduce P loads into the downstream Everglades ecosystem.

BIO: Anne Sexton is a Ph.D. Candidate at the University of Florida in the Soil and Water Sciences Department. She has a Master's degree from Tufts University in Urban and Environmental Policy and Planning and has experience working with urban and agricultural water quality issues.

Contact Information: Anne E. Sexton, Soil and Water Sciences Department, University of Florida, Everglades Research and Education Center. Email: aes9922@ufl.edu

WATER STORAGE AND TREATMENT SERVICES FROM AGRICULTURAL LANDS IN THE NORTHERN EVERGLADES

S. Shukla, *G. Hendricks, N. Shrestha, and R. Sishodia*
Agricultural and Biological Engineering Department, Southwest Florida Research and Education Center, Immokalee, FL , USA

A payment for environmental services (PES) program was started in Florida in 2007 for state agencies to pay ranchers who provide water retention and nutrient (P or N) treatment services that benefit the Lake Okeechobee-Everglades ecosystem. During the design phase, pilot projects were implemented on eight ranches that were expected to provide the services. Each site was instrumented to monitor water and nutrient fluxes. The water treatment site is a 2500-ac impoundment where water from a public canal is pumped to the site for nutrient treatment, and outflow is redirected back into the canal. During the 3-year period, the impoundment removed 11,672 kg (3891 kg/yr) of P and 68,697 kg (22,899 kg/yr) of N from public water. The treatment site provided a high level of nutrient removal with 78% of P and 44% of N being retained. Measurements verified that impoundments can provide the P removal service and provide additional income to the landowners. Hydrologic measurements from two water storage sites, a site with short-term (3 years) and another with long-term (9 years) data, were analyzed. Measurement-based verification of water storage service was masked by rainfall variability. An integrated model (MIKE-SHE) was used to verify water storage services. The model performed satisfactorily (NSE = 0.58 to 0.82). Model results showed a general reduction in surface flows and increased storage. Results from the MIKE-SHE differed significantly with those from a model currently used by the state. The tradeoff between model complexity and accuracy for water-related PES programs will be discussed.

BIO: Dr Sanjay Shukla is a Professor of Water Resources in the Agricultural and Biological Engineering Department and is located at the Southwest Florida Research and Education Center of University of Florida/IFAS. He specializes in watershed hydrology, water quality, and improving water sustainability of agriculture. He has a PhD in Biological System Engineering from Virginia Tech.

Contact Information: S. Shukla, Agricultural and Biological Engineering Department, Southwest Florida Research and Education Center, 2685 SR 29 N, Immokalee, FL 34142, Phone: 239-658-3425, Email: sshukla@ufl.edu

RESTORING PRE-DEVELOPMENT HYDROLOGY IN BISCAYNE BAY: THE RECOVER PLANNING PROCESS

Michael T. Simmons[1] *and Patrick A. Pitts*[2]
[1]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[2]U.S. Fish and Wildlife Service, Vero Beach, FL, USA

RECOVER, which stands for REstoration, COordination & VERification, is a multi-agency team of scientists, modelers, planners, and resource specialists. RECOVER's mission is to "provide essential support to the CERP (Comprehensive Everglades Restoration Plan) in meeting its goals and purposes by applying a system-wide and integrative perspective to the planning and implementation of the Plan. RECOVER conducts scientific and technical evaluations and assessments for improving CERP's ability to restore, preserve, and protect the south Florida ecosystem." One component of the CERP is to restore the hydrology and ecology of Biscayne Bay to natural, pre-development levels. The RECOVER Southern Coastal Systems Regional Team is engaged in the RECOVER planning process to develop a transparent, science-based method leading to the successful restoration of hydrology and ecology in Biscayne Bay.

Identifying desired (i.e., target) hydrological and ecological conditions is a critical, initial step in the restoration process. For estuaries, salinity is perhaps the most critical ecological component for which targets are often established. Over the last several years, RECOVER has been working to establish salinity targets for the western nearshore waters of Biscayne Bay. Here, we present the process and steps taken (and those yet needed) to set those targets; including, identifying a suitable salinity model, use of supporting data and historical information, and development of target scenarios for input to the model.

BIO: Mr. Simmons is a natural resources specialist with 13 years of experience as a coastal biologist in Florida. His focus was on monitoring and protecting coastal species such as sea turtles, shorebirds, wading birds, gopher tortoises, and diamondback terrapins. He also has experience in coastal restoration and habitat improvement projects.

Contact Information: Michael T. Simmons, U.S. Army Corps of Engineers, 701 San Marco Blvd, Jacksonville, FL USA 33207,
Phone: 904-232-2269, Email: michael.t.simmons@usace.army.mi
l

THE EFFECT OF INCREASED FLUID CONDUCTIVITY IN PEAT SOILS FROM THE EVERGLADES: IMPLICATIONS FOR BIOGENIC GAS PRODUCTION AND RELEASE UNDER A SEA LEVEL RISE SCENARIO

Matthew Sirianni *and Xavier Comas*
Florida Atlantic University, Department of Geosciences, Environmental Geophysics Lab, Boca Raton, FL, USA

Sea level rise (SLR) is an increasingly important topic for many low-lying coastal areas such as South Florida. The United States Army Corps of Engineers (USACE) projects that sea level change in South Florida, over the next 50 years, will increase between 0.1 and 0.6 meters. Given the low elevation and its shallow slope, the Everglades region is highly susceptible to changes in sea level. Based on the USACE SLR projections it seems inevitable that previously unexposed freshwater areas of the southern Everglades will become increasingly exposed to saline water. The effects of such saline water intrusion into the current C dynamics of the Everglades (particularly in terms of biogenic gas production and emissions, i.e. CH4 and CO2) is however uncertain. As previously proposed by others, increases in fluid conductivity in peat soils will result in dilation of pore spaces and thus increases in hydraulic conductivity, while limiting methanogenesis. Previous studies investigating the effects of increased fluid conductivity on freshwater peat soils in the Everglades are very limited, and to our knowledge none have intended to monitor the internal gas dynamics within the peat matrix using an array of geophysical and hydrological methods such as ground penetrating radar (GPR), time-lapse photography, gas chromatography, and constant head permeameter tests. Laboratory results showed (1) a progressive decrease in gas content within the peat matrix (i.e. production) and gas releases once fluid conductivity is increased; (2) a progressive increase in hydraulic conductivity once fluid conductivity is increased; and (3) maximum gas releases detected during early stages of pore dilation (after increasing salinity) followed by a progressive decrease in gas release as salinity increased. This study has implications for better understanding how C dynamics in the Everglades may be affected by SLR.

BIO: Matt Sirianni is a graduate student in the Geosciences Department at Florida Atlantic University where he works as part of the Environmental Geophysics Lab.

Contact Information: Matthew Sirianni, Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431, USA, Phone: 607-765-8228, Email: msirianni2014@fau.edu

INVESTIGATING SPATIAL VARIABILITY IN GAS-FLUX DYNAMICS WITHIN BIG CYPRESS NATIONAL PRESERVE, FLORIDA USING HYDROGEOPHYSICAL METHODS

***Matthew Sirianni*[1]**, *Xavier Comas*[1] *and Barclay Shoemaker*[2]
[1]Florida Atlantic University, Boca Raton, FL, USA
[2]U.S.G.S., Davie, FL, USA

Globally, wetland soils play an important role in regulating climate change by functioning as a source or sink for atmospheric carbon, particularly in terms of methane and carbon dioxide. While many historic studies defined the function of wetland soils in the global carbon budget, the gas-flux dynamics of subtropical wetlands is largely unknown. Big Cypress National Preserve is a collection of subtropical wetlands in southwestern Florida, including extensive forested (cypress, pine, hardwood) and sawgrass ecosystems that dry and flood annually in response to rainfall. The U.S. Geological Survey employs eddy covariance methods at several locations within the Preserve to quantify carbon and methane exchanges at ecosystem scales. While eddy covariance towers are a convenient tool for measuring gas fluxes, their footprint is spatially extensive (hundreds of meters); and thus spatial variability at smaller scales is masked by averaging or even overlooked. We intend to estimate small-scale contributions of organic and calcitic soils to gas exchanges measured by the eddy covariance towers using a combination of geophysical, hydrologic and ecologic techniques. Preliminary results suggest that gas releases from flooded calcitic soils are much greater than organic soils. These results - and others - will help build a better understanding of the role of subtropical wetlands in the global carbon budget.

BIO: Matt Sirianni is a graduate student in the Geosciences Department at Florida Atlantic University where he works as part of the Environmental Geophysics Lab.

Contact Information: Matthew Sirianni, Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431, USA, Phone: 607-765-8228, Email: msirianni2014@fau.edu

COASTAL SUBSIDENCE AS A FUNCTION OF SALINITY INTRUSION AND PEAT DECOMPOSITION IN A KARST ENVIRONMENT

Fred Sklar[1], *Carlos Coronado*[2], *Joe Stachelek*[2], *Steve Kelly*[2] *and Tiffany Troxler*[3]
[1]South Florida Water Management District, West Palm Beach, FL USA.
[2]Everglades Division, South Florida Water Management District, West Palm Beach, FL
[3]Dept. of Biological Sciences, Florida International University, Miami, FL. USA

Large scale, restoration of the Everglades hydrology is delayed as the State of Florida designs, builds and manages Stormwater Treatment Areas (STAs) to remove TP from upstream basins. In the mean-time, sea level is rising (2-3 mm per year) and saltwater intrusion into the groundwater has begun. Therefore, we ask two key questions: How long will the resilience of the Florida coastal ecosystems to climate change defer the impacts of saltwater intrusion, increased tidal inundation, and hypersalinity? And, how is the phenomenon of peat collapse associated with sea level rise? To answer these questions, we examined 19 years of Surface Elevation Tables (SETs) in the coastal mangroves of Florida Bay and the first year of a large, in situ salinity dosing experiment from an area in Shark River Slough on the brink of peat collapse and a freshwater area far upstream, many years removed from saltwater intrusion. The porewater chemistry in the brackish sawgrass marsh was very surprising. As expected, Treatment chambers had higher concentrations of salt, chlorides and sulfates, than the Controls. However, they had lower concentrations of total dissolved phosphorus, nitrogen and organic carbon. Concentrations of TDP and TDN averaged around 90 ppb and 5 mg/l respectively, in the Treatment chambers, and 150 ppb and 8 mg/l, respectively, in the Control chambers. The nutrient concentrations in this brackish site were also significantly higher than the freshwater site where, TDP and TDN averaged around 12 ppb and 1.4 mg/l respectively, in the Treatment chambers, and 9 ppb and 0.9 mg/l, respectively, in the Control chambers. The high nutrients in the brackish site suggest high decomposition rates, which agrees with the SET relationships found with hydrology. In continuously flooded mangroves, the annual average elevation change (0.15 cm) was lower than the average annual accretion rate (0.21 cm), indicating that subsidence is high and that these sites cannot keep pace with sea level rise. On the other end of the spectrum, mangroves that occasionally have low water and low salinity, had an elevation increase of 3.1 mm/yr, but interestingly, an accretion of only 0.11 cm/yr. These sites keep pace with sea level rise due to belowground processes; processes that our dosing chambers are illuminating.

BIO: http://conference.ifas.ufl.edu/GEER2017/presenters.html#Fred

Contact Information: Fred Sklar, South Florida Water Management District, 3301 Gun Club Rd. West Palm Beach, FL 33406, Phone: 561-682-6504, Email: fsklar@sfwmd.gov

RISK ASSESSMENT TO INFORM MANAGEMENT DECISIONS: NON-NATIVE FISHES IN EVERGLADES NATIONAL PARK

***Daniel H Slone*[1]**, *Pamela J Schofield*[1], *William F Loftus*[2], *Jeff Kline*[3], *and Denise Gregoire-Lucente*[4]
[1]U.S. Geological Survey, Gainesville, FL, USA
[2]Aquatic Research & Communication, LLC, Vero Beach, FL, USA
[3]National Park Service, Everglades National Park, FL, USA
[4]Cherokee Nations, Gainesville, FL, USA

Dozens of species of non-native freshwater fishes have been introduced to aquatic habitats in Florida, and several of these have established self-sustaining populations in the Everglades. Plans to incorporate invasive species management are now required for Comprehensive Everglades Restoration Plan projects, yet there is a dearth of information on the biology, ecology, and impacts of these species.

A decision-support tool is being developed to allow natural-resource managers to prioritize efforts aimed at prevention, detection, rapid-response and control of potentially invasive non-native fishes. This will be accomplished through comparison of biological and ecological traits of species that have successfully invaded with those that have not That information will be used to predict which fishes currently in the aquarium trade or aquaculture industry but not yet introduced into Florida's waters may present the greatest threat for invasion and establishment.

The tool being developed is a Bayesian Multinomial Logit Choice Model. It uses training species that are native to south Florida or known to have been introduced to the Everglades. Life history characteristics (e.g., fecundity, growth-rate), ecophysiological tolerances (e.g., low-temperature tolerance), ecological aspects (e.g., habitat use), and behavior (e.g., parental care of offspring, aggression) are parameters in the model and together they inform the probability of outcomes (e.g. population density or spatial extent) related to invasion success. The model estimates the risk of invasion of potential invasive species (i.e. test species), for both level of invasiveness and the uncertainty of the prediction.

This decision-support tool will help managers predict which non-native freshwater fishes have the greatest likelihood of invading south Florida's National Parks. This tool can also focus monitoring and control efforts toward high-risk species along park boundaries. Alternatively, attempts to exclude particularly invasive fishes could be attempted. Additionally, the risk assessment will inform decisions on whether or not (and how) to respond to new invasions. For example, a species rated as highly likely to establish may warrant a more vigorous response (e.g., use of ichthyocide, dewatering) than one that is less likely to proliferate throughout the park. The information from the quantitatively based risk assessment, when shared with other federal or state management agencies, could convince managers to fund cooperative efforts that focus on the control of particularly troublesome fish species, as is now the case with invasive plants and reptiles.

BIO: Daniel Slone has a research emphasis on bridging theoretical and applied ecology and management. He works with West Indian manatees in Florida and the Caribbean, crocodilians in Florida, and invasive aquatic organisms, specializing in landscape-level analysis and ecological modeling.

Contact Information: Daniel H. Slone, Research Ecologist, USGS Wetland and Aquatic Research Center, 7920 NW 71st Street, Gainesville, FL 32653 USA, Email: dslone@usgs.gov

STABLE ISOTOPES REVEAL REMARKABLE NICHE PLASTICITY OF INVASIVE BURMESE PYTHONS

Brian J. Smith[1], *Kristen M. Hart*[2], *Amanda W.J. Demopoulos*[3], *and Christina M. Romagosa*[4]
[1]University of Florida, Ft. Lauderdale Research and Education Center, Davie, FL, USA
[2]U. S. Geological Survey, Wetland and Aquatic Research Center, Davie, FL, USA
[3]U. S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA
[4]University of Florida, Gainesville, FL USA

Globally, invasive predators pose a major threat to native biodiversity. This threat most obviously applies to potential prey species, which can be affected both directly and indirectly, but another suite of impacts can occur through competition with native predators. Understanding the new predator's realized niche in the invaded system is therefore important for predicting and managing the potential effects of these invasives, including protecting native species threatened by both predation and competition. The Burmese python is an invasive predator in the Greater Everglades Ecosystem (GEE) that has caused major damage to the native food webs and drastically changed the mammal community in the core of the invaded range. Eradication of pythons is not feasible in the short-term, so management efforts will likely focus on protecting imperiled native species. Predicting which species are most vulnerable to pythons is crucial for this effort.

Although the concept of the niche is widespread in ecology, quantifying niche space has always posed a significant challenge. Recently, the isotopic niche – a space measured through stable isotope analysis of carbon and nitrogen – has emerged as an effective method to quantify both the habitat and dietary components of an organism's niche. To measure the isotopic niche of Burmese pythons, we analyzed the isotopic composition of muscle tissue from 403 individual Burmese pythons captured throughout the southern half of the GEE. We calculated standard ellipse areas (SEAs) for pythons from six regions of the GEE, and following a thorough literature review, compared python SEAs in each of these regions to published values from diverse animal taxa.

Across the entire ecosystem, python SEAs were large (8.99 ‰^{2}) compared to values from other taxa in the literature (mean = 4.06 ‰^{2}), suggesting a generalist diet. However, python SEAs varied widely throughout the landscape, with pythons from Water Conservation Areas 2 and 3 having the smallest SEA (3.58 ‰^{2}) and pythons from western Collier County having the largest SEA (17.0 ‰^{2}). These values likely reflect the diversity of available prey and habitats in the respective areas, and this high niche plasticity is likely a major contributing factor in their invasion success. Further research into the niche size of native predators would give a strong indication of which species are most vulnerable to the impacts of the python invasion.

BIO: Brian is a wildlife research technician with the University of Florida, based out of Davie, FL. He completed his M.S. in Wildlife Ecology and Conservation at UF in December 2016, studying the spatial ecology of pythons in the Greater Everglades Ecosystem using stable isotopes and GPS biologging tags.

Contact Information: Brian J. Smith, University of Florida, 3205 College Ave, Davie, FL, USA 33314, Phone: 954-377-5992,
Email: bsmity13@ufl.edu

USING GPS BIOLOGGING TECHNOLOGY TO TRACK MOVEMENTS OF INVASIVE BURMESE PYTHONS

Brian J. Smith[1], *Kristen M. Hart*[2], *Frank J. Mazzotti*[1], *Mathieu Basille*[1], *and Christina M. Romagosa*[3]
[1]University of Florida, Ft. Lauderdale Research and Education Center, Davie, FL, USA
[2]United States Geological Survey, Wetland and Aquatic Research Center, Davie, FL, USA
[3]University of Florida, Gainesville, FL USA

Burmese pythons established in the Greater Everglades Ecosystem (GEE) three decades ago, and since then, they have posed a direct threat to many native species and are likely responsible for severe mammal declines in Everglades National Park. Because of these detrimental effects on the ecosystem, the Burmese python is the focus of large-scale management efforts. All of the currently-implemented removal tools rely on visual searching by humans, either from a vehicle or on foot, and subsequent hand-capture of the detected python. However, pythons are cryptic ambush predators, and these natural history characteristics make them exceptionally difficult for humans to detect. Successful removal is much more likely when pythons are actively moving, e.g., crossing a road or levee. Existing management efforts could be optimized if we can identify environmental conditions that cue python movement and thus make detection and removal much more likely.

Telemetry is the ideal tool to study movement patterns, and VHF radio-telemetry has been used to study pythons in the GEE since 2006. However, due to logistical limitations, it is impossible to obtain the frequent locations required to optimize removal efforts with VHF tracking alone. GPS telemetry is much more efficient for obtaining a high frequency of accurate locations, and recently, GPS biologgers (i.e., tags that store the GPS location data on-board) have become small enough to implant in large snakes. We fitted wild Burmese pythons with GPS-biologging tags that would attempt to record their location every 90-minutes. We deployed GPS-tagged pythons in two study seasons to measure seasonal variability in movements: August – October 2015 (6 pythons), and January – March 2016 (7 pythons). From the resulting dataset, we evaluated the performance of the technology and identified python movement patterns when possible.

Of the 13 GPS-tagged python deployments, 4 resulted in failures in which no data were retrieved (31%). The successfully recovered tags had a generally low GPS fix rate (i.e., proportion of attempted GPS fixes that were successful) of 17.9%; this low rate is not surprising for an animal that spends its time in thick cover. After filtering inaccurate locations, an average of 186.4 valid fixes/snake were available for analysis, representing approximately 13.5 valid locations/snake/week. From the valid fixes, we were able to estimate the proximate meteorological conditions that best predict python movement, including air temperature, relative humidity, and wind speed. We were also able to examine how pythons move near roads by using a step selection function. Further GPS tracking will help to generalize these patterns across seasons and elucidate differences within the python population.

BIO: Brian is a wildlife research technician with the University of Florida, based out of Davie, FL. He completed his M.S. in Wildlife Ecology and Conservation at UF in December 2016, studying the spatial ecology of pythons in the Greater Everglades Ecosystem using stable isotopes and GPS biologging tags.

Contact Information: Brian J. Smith, University of Florida, 3205 College Ave, Davie, FL, USA 33314, Phone: 954-377-5992, Email: bsmity13@ufl.edu

THE ROLE OF TIDES IN GROUNDWATER-SURFACE WATER EXCHANGE IN THE SHARK RIVER, FLORIDA COASTAL EVERGLADES, FLORIDA.

***Christopher G. Smith*[1]**, *René M. Price*[2], *Peter W. Swarzenski*[3,4], *and Jeremy C. Stalker*[5]
[1]USGS St. Petersburg Coastal and Marine Science, St. Petersburg, FL, USA
[2]Department of Earth and Environment & Southeast Environmental Research Center, Florida International University, Miami, FL, USA
[3]USGS Pacific Coastal and Marine Science Center, Santa Cruz, CA, USA
[4]IAEA Environment Laboratories, Monaco, Principality of Monaco
[5]Department of Biological and Marine Sciences, Jacksonville University, Jacksonville, FL, USA

Low-gradient environments like the Florida Coastal Everglades (FCE) are hydrologically complex, where surface and subsurface processes are intimately linked and hard to separate. Fluid exchange within these low- gradient systems can occur across broad spatial- and temporal-scales, with variable contributions to material transport and transformation. Identifying and assessing the scales at which these processes operate is essential for accurate evaluations of how these systems contribute to global biogeochemical cycles. Based on field data, tidal pumping and active irrigation of crab burrows, which are effectively macropores, within the mangrove peats drive high radon fluxes observed throughout a tidal cycle. Burrows are irrigated during rising tides when radon and other dissolved constituents are released from the mangrove soil. Therefore, tidal pumping of the mangrove forest soil acts as a significant vector for exchange between the forest and the estuary. Processes that enhance exchange of O_2 and other materials across the sediment-water interface could have a profound impact on the environmental response to larger scale processes such as sea-level rise and climate change. Compounding the material budgets of the Shark River Slough Estuary are additional inputs from groundwater from the Biscayne Aquifer. Quantification of the deep groundwater component is not obtainable but isotopic data suggest a more prevalent signal in the dry season. These findings highlight the important role that both tidal- and seasonal-scale forcings play on groundwater movement in low-gradient hydrologic systems.

BIO: Christopher G. Smith, PhD is a Research Geologist with St. Petersburg Coastal and Marine Science Center, where he conducts research on coastal processes related to the exchange of dissolved and particulate constituents in estuaries, wetlands, and open-shoreline environments.

Contact Information: Christopher G Smith, Research Geologist, USGS - St. Petersburg Coastal and Marine Science Center, 600 4th St. S., St. Petersburg, FL 33701, Phone: (727) 502-8035, Email: cgsmith@usgs.gov

BIOTIC RESISTANCE IN WEED BIOLOGICAL CONTROL

Melissa C. Smith[1], *Ellen C. Lake*[1], *Carey R. Minteer*[2], *Min Rayamahji*[1], *Gregory S. Wheeler*[1], *Philip Tipping*[1]
[1]USDA-ARS Invasive Plant Research Laboratory, Fort Lauderdale, FL, USA
[2]University of Florida, IFAS, Indiana River Research and Education Center, Fort Pierce, FL, USA

Introduced species are often thwarted from establishing in a new range due to strong interactions with native residents. Indigenous species act as direct competitors, predators, parasites and pathogens to all novel species, including species introduced to aid in the control of invasive species. Classical weed biological control relies upon introduced natural enemies to provide control in the invaded range. The efficacy of these efforts though can be greatly reduced and even altogether obstructed when native parasitoids and pathogens attack the biological control agent. To decrease the risk of failed introductions, can biological control researchers utilize pre-screening tools to focus on less vulnerable groups?

Most risk assessment in regards to biological control insects revolves around reducing risk **to** native species from introduced biological control agents due to shifts in fundamental host range. However, nearly 20% of biological control introductions fail to reach populations high enough to be considered successful due to predation, parasitism and pathogens in the introduced range.

We outline successes and failures in biological control efforts, with a focus on the Greater Everglades Ecosystem, due to biotic resistant and how those guide search criteria for subsequent agents.

BIO: Dr. Smith is a research ecologist with the Invasive Plant Research Laboratory in Davie, Florida. Her experience in the Everglades began in 2005 with the National Park Service and continues today as she investigates ways to integrate ecology and biological control to mitigate the damaging effects of invasive species.

Contact Information: Melissa C. Smith, USDA-ARS Invasive Plant Research Laboratory, Fort Lauderdale, FL, USA 33314,
Phone: 954.475.6577, Email: Melissa.smith@ars.usda.gov

INFLUENCE OF VEGETATION ON SOIL PHOSPHORUS FORMS IN THE EVERGLADES STORMWATER TREATMENT AREAS (STA): STA-2 AS A CASE EXAMPLE

***Taylor Smith*[1]**, *Lilit Vardanyan*[1], *R. Bhomia*[1], *Odi Villapando*[2], *Alan Wright*[1], *and K.R. Reddy*[1]
[1]University of Florida, Gainesville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

The Stormwater Treatment Areas (STAs) of the Everglades, were designed and are operated to retain phosphorus (P) and reduce P concentration in the water column in accordance with water quality standards. One way to reduce P is to assimilate it into the soil. Characterizing the relative lability or recalcitrance of the P assimilated can be important in determining the potential of releasing P back into the water column. Understanding the different dominant vegetation types and their influence on the properties of accreted P fractions can provide insight for short-term and long-term P retention in the STAs. STA-2 Cell 1 and STA-2 Cell 3 have been selected for study based on dominant vegetation types, i.e. emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV), respectively. Our results showed that the SAV-dominated cell is accumulating more inorganic P than organic P, while EAV cell is accumulating relatively more organic P than inorganic P. Long-term stability of this stored P depends on the reactivity of the materials accumulated in soils.

BIO: Taylor Smith is a graduate student working towards his master's degree in Soil and Water Science. His work is in determining ways to sequester phosphorus into more recalcitrant forms, thereby retarding phosphorus re-entry into the water column of the Everglades Stormwater Treatment Areas.

Contact Information: Taylor Smith, Wetland Biogeochemistry Lab, University of Florida, Gainesville, FL 32611, Phone: (352)-213-5638, Email: t.smith21@ufl.edu

HOW LONG CAN SOIL ACCRETION IN MANGROVE FORESTS KEEP UP WITH FUTURE SEA-LEVEL RISE? INSIGHTS FROM THE GREATER EVERGLADES

Joseph M. Smoak[1], *Joshua L. Breithaupt*[2], *Ryan P. Moyer*[3] *and Christian J. Sanders*[4]
[1]University of South Florida, Environmental Science, St. Petersburg, FL, USA
[2]University of South Florida, College of Marine Science, St. Petersburg, FL, USA
[3]Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Saint Petersburg FL 33701, USA
[4]National Marine Science Centre, Southern Cross University, Coffs Harbour, Australia

Over the past several millennia mangrove forests have expanded under relatively stable sea-level conditions. However, the global rate of sea-level rise (SLR) is expected to accelerate and, in South Florida, sea level is projected to range from 23 to 61 cm above 2010 levels by the year 2060. While changes to precipitation, temperature and cyclone activity, for example, may impact mangrove forests, it is accelerating SLR that is of greatest immediate concern because if the accretion rate fails to keep pace then all ecosystem services, including carbon burial, will likely collapse. Mangrove forests sequester organic carbon (OC) in their soils at rates much greater on a per-area basis than those found in other types of forests. This restricts a large quantity of OC to a relatively small area along tropical and sub-tropical coastal margins, where dramatic climate-driven impacts are expected. Hence this small yet highly vulnerable area will have a disproportionally large impact on global carbon cycling. To investigate the fate of mangrove forests in the Greater Everglades, we measured OC burial and accretion rates in soils over the last 100 years (via ^{210}Pb dating) from 18 sites in the Ten Thousand Islands area and Everglades National Park. Mean peat accretion rates were not significantly different than the relatively modest average SLR over the last 100 years, but rates may not have kept pace with the substantially higher SLR in the last decade. In addition, we utilize a range of rates from the soil record combined with regional tidal ranges and SLR projections to estimate maximum potential future accretion rates and to speculate about timeframes when sites may become permanently submerged.

BIO: Joseph M. Smoak is a professor of biogeochemistry at the University of South Florida in St. Petersburg. His research focus is on how coastal wetlands respond to climate change and sea-level rise. Specifically, his work examines carbon burial in coastal wetlands, and how burial might change and influence global climate.

Contact Information: Joseph “Donny” Smoak, University of South Florida, Apollo Beach, FL USA 33572, Phone: 727-873-4078, Email: smoak@mail.usf.edu

THE RESPONSE OF MUHLY GRASS (*MUHLENBERGIA CAPILLARIS* VAR. *FILIPES*), A PRAIRIE DOMINANT, TO FIRE AND FLOODING

***James R. Snyder*[1]**, *Jay P. Sah[2], and Michael Ross[2]*
[1]Naples, FL, USA
[2]Florida International University, Miami, FL, USA

Muhly grass (*Muhlenbergia capillaris* var. *filipes* or *Muhlenbergia sericea*) is a C_4 perennial bunch grass with needle-like leaves that reaches about 1 m in height and nearly the same in diameter. Muhly is often a common component of the short-hydroperiod wet prairies that constitute habitat for the Cape Sable seaside sparrow. These prairies are highly flammable habitats subject to natural and human-caused wildfires. We have studied the response of muhly to fire in a series of field experiments utilizing small burns in Everglades National Park and Big Cypress National Preserve and through multi-year monitoring of vegetation plots in Cape Sable seaside sparrow habitat.

The results of these studies show that, in the absence of flooding, muhly regrows rapidly after fire and can reach preburn heights within 3 months. However, if water levels rise above the soil surface soon after burning there can be depressed growth or mortality. Severe drought conditions at the time of burning can also result in slower regrowth or plant death. Muhly exhibits very little flowering in unburned prairies but fire stimulates abundant flowering, the effect most pronounced after fires in May and June, the period that normally coincides with the transition from dry to wet conditions in the field. Therefore, fire management must take into account that fires during the spring may be most beneficial for muhly reproduction but have the highest risk of flooding-induced mortality.

BIO: Dr. Snyder is a retired plant ecologist with more than 3 decades of experience with the Department of the Interior in south Florida.

Contact Information: James R. Snyder, 1310 15th St. SW, Naples, FL, USA 34117, Phone: 239-272-4481,
Email: jimsnyder_naples@yahoo.com

WERP: HOW AN OBSOLETE LEVEE AND A DEFUNCT JETPORT HOLD THE KEY TO A RAIN-DRIVEN SWAMP

Robert V. Sobczak*[1]*, *Michael J. Duever*[2]*, Kelly J. Keffe*[3]*, Antonio J. Pernas*[1]*, John F. Meeder*[4]

[1]Big Cypress National Preserve, Ochopee, FL, USA
[2]Natural Ecosystems, Naples, FL, USA
[3]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[4]Southeast Environmental Research Center, Florida International University, Miami, FL, USA

Big Cypress National Preserve is often celebrated in modern times as a “rain-driven” ecosystem in which rainfall − not upstream flows − provides the primary source of water for filling its swamp forested expanse. Under this conceptualization, the preserve is envisioned as a hydrologic Brigadoon of sorts in which progressive planning in the early 1970s – namely, the decision to carve the preserve’s parochial bounds to coincide with the catchment that delivers freshwater flow to the western estuarine arm of Everglades National park – saved the swamp and, in one fell swoop, achieved what has become a decades-long and quite arduous restoration of the Okeechobee-Everglades (KOE) flow way to the east. Central to this widespread line of reasoning is the assumption that the some 35 miles of Central and South Florida (C&SF) Project drainage works that forms the preserve’s eastern boundary – commonly called the L-28 – was placed along a physiographic boundary, and therefore has had little to no effect. While a paucity of hydrologic data in this mysterious “swamp-meets-glades” confluence (aka the Western Everglades) has helped perpetuate this notion into the modern era, it is ultimately *history* (not hydrologic models) that unravels the profound ecological impact of the levee and, in the process, punctures a hole in the sophistry of the swamp’s “rain-driven” myth.

BIO: Mr. Sobczak is a hydrologist with the National Park Service with 18 years of experience at Big Cypress National Preserve. He is author of the *Go Hydrology* website, an online journal that chronicles and celebrates the water cycle of south Florida.

Contact Information: Robert V. Sobczak, Big Cypress National Preserve, 33100 Tamiami Trail East, Ochopee, FL, USA, 34141, Phone: 239-695-1151, Email: robert_sobczak@nps.gov

ASSESSING THE SUCCESS OF HYDROLOGICAL RESTORATION IN TWO CONSERVATION EASEMENTS WITHIN THE HEADWATERS OF THE EVERGLADES

Grégory Sonnier[1, 2]*, Elizabeth H. Boughton*[1, 2]*, Patrick J. Bohlen*[3]*, Steve L. Orzell*[4]*, Edwin L. Bridges*[5]*, Hilary M. Swain*[3]

[1]Archbold Biological Station, Venus, FL, USA
[2]MacArthur Agro-Ecology Research Center, Lake Placid, USA
[3]University of Central Florida, Orlando, Florida, USA
[4]Avon Park Air Force Range, Avon Park, Florida, USA
[5]Botanical and Ecological Consultant, Bremerton, WA

Wetlands are important but threatened ecosystems worldwide. In the headwaters of the Everglades watershed many wetlands were lost or degraded following drainage and conversion to pastures. The drainage of these wetlands and ensuing farming practices had negative impacts on wetland communities as well as negative downstream impacts on Lake Okeechobee and the Everglades. The USDA NRCS Wetland Reserve Program (WRP) was specifically developed to preserve and restore degraded and lost wetlands. The program provides technical and financial support to private landowners willing to engage in wetland restoration. Since the creation of the WRP program in 1985, only minimal effort has been expended to quantify the effects of the program on the goals set forth for wetland restoration. It is essential to fully understand the results of current restoration practices on the success of wetland restoration. Invasive species, a flat landscape, and sandy soils can make wetland restoration a challenge in Florida. Although Florida has the greatest amount of acres enrolled in WRP, no published monitoring data exist to determine the success of these wetland restorations

Here, we study the success of wetland restoration in two conservation easements enrolled in the Wetland Reserve Program in south-central Florida. More specifically, we test whether hydrological restoration was effective in restoring wetter conditions within these easements. We also test if restoration was successful in shifting vegetation towards communities better adapted to wet conditions, and in increasing plant biodiversity particularly in pasture communities dominated by Bahia grass (*Paspalum notatum*).

The two conservation easements (total of 750 acres) are located at the MacArthur Agro-Ecological Research Center, a fully operational cattle ranch in South Central Florida. Hydrological restoration utilizing a variety of water control structures and ditch plugs occurred in 2008 at these two sites. We monitored water level using ground water wells with automated pressure transducers located within and outside the two easements between 2003 and 2014. We expected restored wetlands to retain more water (higher water table) and for a longer period of time (higher hydroperiod). We also monitored vegetation in 2005 (pre-restoration) and 2012 (post-restoration) using permanently located transects and quadrats for a total of 300 1m^2 surveyed quadrats. We expected biodiversity and the proportion of obligate wetlands species to increase following restoration.

BIO: Dr. Sonnier is a postdoctoral fellow with expertise in plant community ecology and plant functional ecology. His work at MacArthur Agro-Ecological Center focuses on understanding how ranching and wetland restoration affect wetland plant communities.

Contact Information: Gregory Sonnier, Mac Arthur Agro-Ecological Research Center, 300 Buck Island Ranch Road, Lake Placid, FL, USA 33852, Phone: (608)-228-0966, Email: gsonnier@archbold-station-org.

HYDROPERIOD ANALYSIS TOOLSETS: INNOVATIVE TOOLS TO BUILD NEW ANALYSES

***Lawrence Spencer*[1]**, *Sandra Fox*[2], *and Steve Bourne*[3]
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]St. John's River Water Management District, Palatka, FL, USA
[3]AECOM, West Palm Beach, FL, USA

In wetland ecology, inundation frequency, duration, and depth are crucial information for understanding organismal relationships to flood pulses and for predicting wetland habitat locations. Using Python Scripts and leveraging ArcGIS and web applications, we are building a suite of analysis tools that will allow scientists to measure the spatial interactions between hydroperiod and habitat.

With ESRI grid data derived from output of the South Florida Water Depth Analysis Tool (SFWDAT) or other sources, Python scripts developed at the South Florida Water Management District (SFWMD) allow scientists to look at inundation duration at specific locations and do a number of analyses overlaying habitat or species distribution GIS layers on depth grids. Other Python tools allow for analysis of stage-storage relationships of any water body at multiple water elevations, or allow for hydroperiod analysis of small or large lakes.

A separate but related wetland analysis tool being developed in collaboration with the co-authors at St. John's River Water Management District will allow for more inclusive and in-depth wetland inundation analyses. These tools are web-based and system-agnostic, so they will not depend on the use of ESRI or other proprietary platforms to function. Demonstrations and resultant outputs from the toolsets will be presented.

BIO: Dr. Spencer is a plant ecologist and wetland mapping specialist with ten years of experience working on hydrologic and ecological projects within the Kissimmee River basin, including extensive vegetation mapping projects for the Kissimmee River Restoration Evaluation Program (KRREP) and management of the KRREP Hydroperiod Tool.

Contact Information: Lawrence Spencer, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406, Phone: 561-682-2495, Email: lspencer@sfwmd.gov

PUBLIC ENGAGEMENT STRATEGIES TO ADDRESS TODAY'S COMPLEX ISSUES

Mike Spranger
University of Florida, Florida Research and Education Center, Davie, FL, USA

Today we live in a society where there are conflicting perspectives, values and beliefs on today's environmental, economic and social issues. These issues are often complex. Some have even called them "wicked" (Rittel and Webber, 1973). They are wicked not because they are evil or bad. Rather the term describes issues that are difficult to solve because they may be incomplete, contradictory or continually changing. Because of the interdependency and complexity of the issues, the effort to solve one aspect of a wicked issue may reveal or create other problems. The wickedness is often used denote the resistance to its resolution due to the various values, beliefs and perspectives we bring with us when we address these issues (not that they are evil).

How can decision-makers, stakeholders and interested public become better engaged and involved in these issues that impact them? What is the role of scientists and decision-makers in the public engagement process? At its core, engagement follows the same decision-making and solution-finding path that should be familiar to all of us who came of age in the traditional academy. The roles and responsibilities of the participants are clear. What differs is who plays those roles and how different participants interact with each other to advance the agenda (*Mathews, 2006*).

What are some tools and techniques that can be utilized to bring all to the table to discuss and become engaged in the discussion and resolution of these wicked issues? There are a number of tools and techniques that can be utilized to address such complex issues as Everglades Restoration or Climate Change. These tools differ as one determines how we might engage the stake-holders and interested publics. Do we want to inform, consult, involve, collaborate or empower these individuals? (IAP2, 2007). Depending on the objective, different tools and techniques can be utilized.

They may also be new approaches to these issues. Some contend that working on these wicked issues involves a social process that resembles the fable of the blind men and the elephant. The approach may require a holistic and process oriented approach that is by nature adaptive, participatory, and transdisciplinary.

This presentation will provide an overview of the concept of wicked issues, tools and techniques that can be utilized by scientists, decision-makers and stakeholders to address these issues, and set the stage for dialogue and discussion for the other speakers and attendees of this session.

BIO: Mike Spranger is Professor and Extension Specialist at the University of Florida. Current interest is in the area of community development and capacity building to address complex issues. He has PhD from Portland State University, M.S. and M.P.A degrees from University of Wisconsin-Madison and B.A degrees from University of Wisconsin-Parkside.

Contact Information: Mike Spranger, Department of Family, Youth and Community Sciences, University of Florida, P.O. Box 110310, Gainesville, Florida, USA. 32611-0310 Phone: 253-273-33557, Email: spranger@ufl.edu

RESPONSES OF AMERICAN CROCODILES TO ENVIRONMENTAL CONDITIONS AT A POWER PLANT SITE IN SOUTHERN FLORIDA

***Michiko Squires*[1]**, *Jeffrey S. Beauchamp*[1], *Christopher Smith*[2] *and Frank J. Mazzotti*[1]
[1]University of Florida, Fort Lauderdale Research and Education Center, Davie, FL USA
[2]Welleby Veterinary Hospital, Sunrise, FL USA

The American crocodile (*Crocodylus acutus*) is a top predator that lives along the southern tip of peninsular Florida. Crocodiles inhabit coastal areas in mangrove-lined ponds, creeks, coves, man-made ponds, and canals. In 1975, the American crocodile was federally listed as an endangered species. Conservation and management have helped the southern Florida crocodile population rebound, resulting in its reclassification to threatened in 2007. The reclassification of the US population was in part due to the success of a nesting colony at Florida Power & Light's Turkey Point Power Plant (TP).

Today, there are more crocodiles in more places in Florida than there were in 1975. However, nearly all of the increase is due to crocodiles occupying and nesting in human-made habitats, such as canal banks in TP. These habitats provide ideal nesting conditions: elevated sites that are protected from wind and waves, free from human disturbance, and in close proximity to nursery habitat. The first American crocodile was reported at TP in 1976, and the population there has since flourished. A program was implemented in 2009 to monitor distribution, abundance, and body condition through spotlight and capture surveys. In 2013, system-wide changes in water temperature and salinity were detected, and we observed a decline in both crocodile abundance and overall body condition was observed. From May 2015 to November 2016, we investigated the potential causes of these declines at the clinical level. Blood was collected from *C. acutus* throughout TP and compared to samples from crocodiles in nearby Everglades National Park (ENP). These samples were analyzed for 33 parameters related to stress and health.

Blood panels showed that American crocodiles had elevated sodium and chlorine levels, as well as elevated corticosterone compared to crocodiles from ENP. Elevated levels of sodium and chlorine are commonly associated with dehydration, and elevated corticosterone suggests that TP crocodiles exhibited higher stress relative to ENP individuals.

Crocodiles are sensitive to environmental changes, and are a well-known species that is easy for both decision-makers and the public to understand. As estuaries are restored to a more natural pattern, we expect to see increases in relative abundance, growth, and survival of hatchlings, and a continued increase in nesting. These characteristics make the crocodile an important indicator to communicate progress of restoration in Greater Everglades ecosystems.

BIO: Michiko Squires has worked extensively in Greater Everglades ecosystems since 2006. As a wildlife biologist, she currently works in the Croc Docs lab studying crocodylian responses to Everglades restoration.

Contact Information: Michiko Squires, University of Florida, Fort Lauderdale Research and Education Center, 3205 College Avenue, Davie, FL USA 33314, Phone: 954-577-6405, Email: m.squires@ufl.edu

MOLLUSCAN RESPONSE DUE TO 2015 SEAGRASS DIE-OFF IN WESTERN FLORIDA BAY

Bethany Stackhouse[1]*, and Andre Daniels*[2]
[1]U.S. Geological Survey, Reston, VA, USA
[2]U.S. Geological Survey, Davie, FL, USA

Florida Bay is feeling the effects of a massive seagrass die-off that began in late summer of 2015. The lack of rainfall in South Florida at the beginning of the wet season in 2015 led to increased salinity in Florida Bay as high as 70 psu at some locations and contributed to the rapid and widespread death of *Thalassia testudinum* and other seagrasses. Beginning in September of 2015, we have surveyed the ecological conditions on an eight week basis in the following areas of concern: Rankin Basin, Johnson Key Basin, Rabbit Key Basin, and Whipray Basin. Our studies have focused on monitoring water quality, seagrass condition, and mollusk species diversity and abundance.

Samples were collected to assess the number and species of mollusks living on the grass blades and in the substrate as well as what appear to be very recently dead mollusks. Seagrass assessments were also performed using the Braun-Blanquet method in order to determine the species of seagrass, coverage estimates, and the overall health of the surveyed areas. Throughout the study, the four basins have been in different phases of the die-off sequence. In late 2015, Rankin Basin was showing signs of complete die-off and by March 2016 the bottom was mostly bare, but floating mats of dead seagrass were no longer present and there was an improvement in water quality. Currently Rankin Basin has a small, but noticeable amount of new seagrass growth. The seagrass at Johnson Key Basin was moderate to patchy by the end of 2015. The area seemed to show some signs of improvement in early 2016 with healthy *Thalassia* patches and abundant gastropods, but numerous bare areas with no vegetation were still present in October of 2016. Throughout our survey, Rabbit Key Basin has been the least affected by the current die-off. The seagrass in this area has continued to be dense and healthy despite some floating mats of vegetation seen in June 2016. The water quality and number of live invertebrates has remained high. We did not start monitoring Whipray Basin until it became an area of concern in January 2016. The seagrass beds in Whipray Basin have been healthy and dense to patchy, but started showing signs of potential die-off in October 2016.

According to hydrologic monitoring stations in the basins, all four sites reached peak salinity levels in mid-July 2015 with Rankin Basin reaching the highest salinity level at 66 psu. The lowest number of live and recently dead mollusks was seen in our vegetation samples collected from the sites in November 2015. There was a 60-94% decrease in live mollusks collected in November 2015 compared to September 2015 samples. It appears that the mollusk populations tolerated the high salinity levels, but once the seagrass began decomposing in massive quantities leading to low oxygen levels and high sulfide and nutrient concentrations, the mollusks began to die off. Decreases in molluscan abundance in faunal assemblages in Florida Bay cores could potentially indicate undocumented seagrass die-off events in the past.

BIO: Bethany Stackhouse is a physical science technician working at the USGS since 2009 on the Greater Everglades Ecosystem Restoration using paleoecologic techniques to interpret Holocene estuarine ecosystems.

Contact Information: Bethany Stackhouse, Eastern Geology and Paleoclimate Science Center, U.S. Geological Survey, 12201 Sunrise Valley Drive, MS926A, Reston, VA 20192 USA, Phone: 703-648-6092, Email: bstackhouse@usgs.gov

THE ECONOMIC SIGNIFICANCE OF FLORIDA BAY

***G. Andrew Stainback*[1]**, *Tony Fedler*[2], *Yogesh Khare*[1]
[1]Everglades Foundation, Palmetto Bay, FL USA
[2]University of Florida, Gainesville, FL USA

Florida Bay provides substantial benefits to society. These benefits include providing crucial habitat for numerous threatened and endangered species (e.g., smalltooth sawfish and American crocodile), recreationally-important fisheries (e.g., snook, tarpon, and redfish), commercially-important fisheries (e.g., stone crab and spiny lobster), and species of wading and migratory birds (e.g., reddish egret, roseate spoonbill, and white pelicans). Due to its incredible array of habitat offerings, Florida Bay also provides numerous opportunities for recreation, whether fishing, kayaking/canoeing, or birdwatching. Due to its vast area of seagrass meadows and mangrove forests, Florida Bay is also noteworthy in terms of its provisioning of important environmental functions such as mitigation of climate change and storm surge. Such benefits are often referred to as ecosystem services.

This study analyzed the economic significance of Florida Bay using two basic approaches. First, the monetary value of benefits that Florida Bay provides to people in terms of recreational fishing, commercial fishing, its impact on home values, and the value of climate change mitigation (via carbon stored in seagrass beds) was analyzed using information from a variety of sources. In addition, the annual economic impact in Florida of recreational and commercial fishing was estimated through conducting a survey of recreational anglers and fishing guides and utilizing the results in an input-output analysis conducted with IMPLAN software.

The results indicate that the ecosystem service benefits provided by Florida Bay are over $14 billion with recreational fishing providing over $6 billion and carbon sequestration providing over $4.5 billion in benefits. This is likely an underestimate as conservative assumptions were made in conducting calculations and only a subset of ecosystem service benefits were analyzed. In addition, the annual economic impact of recreational fishing in Florida Bay was estimated to be over $500 million and the impact of commercial fishing (for pink shrimp and grey snapper) is almost $20 million. The substantial significance demonstrated in this study of the ecosystem services produced by Florida Bay hopefully will provide some insight into the importance of protecting it and the Everglades on which it depends.

<u>BIO</u>: Dr. G. Andrew Stainback is an ecological economist. He has expertise in economics, social science and environmental policy. Over the past fifteen years, he has conducted research on the economics of ecosystem services, the human dimensions of natural resource management, and sustainable development in both domestic and international contexts.

<u>Contact Information</u>: G. Andrew Stainback, Everglades Foundation, 18001 Old Cutler Road, Suite 625, Palmetto Bay, FL 33157, Phone: 305-251-0001, Email: astainback@evergladesfoundation.org

SEASONAL PATTERNS IN EVERGY PARTITIONING OF EVERGALDES FRESHWATER MARSHES

*Sparkle L. Malone[1], Junbin Zhao[2], Christina L. Staudhammer[3], Steven F. Oberbauer[2], and **Gregory Starr**[3]*
[1]Rocky Mountain Research Station, U.S. Forest Service, Fort Collins, Colorado, USA
[2]Department of Biological Sciences, Florida International University, Miami, Florida, USA
[3]Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama, USA

We analyzed energy partitioning in short- and long-hydroperiod freshwater marsh ecosystems in the Florida Everglades by examining energy balance components (eddy covariance derived latent energy (LE) and sensible heat (H) flux). The study period included several wet and dry seasons and variable water levels, allowing us to gain better mechanistic information about the control of and changes in marsh hydroperiods. The annual length of inundation is ~5 months at the short-hydroperiod site (25°26′16.5″N, 80°35′40.68″W), whereas the long-hydroperiod site (25°33′6.72″N, 80°46′57.36″W) is inundated for ~12 months annually due to differences in elevation and exposure to surface flow. In the Everglades, surface fluxes feed back to wet season precipitation and affect the magnitude of seasonal change in water levels through water loss as LE (evapotranspiration (ET)). At both sites, annual precipitation was higher than ET (1304 versus 1008 at the short-hydroperiod site and 1207 versus 1115 mm yr-1 at the long-hydroperiod site), though there were seasonal differences in the ratio of ET:precipitation. Results also show that energy balance closure was within the range found at other wetland sites (60 to 80%) and was lower when sites were inundated (60 to 70%). Patterns in energy partitioning covaried with hydroperiods and climate, suggesting that shifts in any of these components could disrupt current water and biogeochemical cycles throughout the Everglades region. These results suggest that the complex relationships between hydroperiods, energy exchange, and climate are important for creating conditions sufficient to maintain Everglades ecosystems.

BIO: Dr. Zhao is a post-doctoral scientist with ~4 years of experience working on ecosystem studies. He has extensive experience with wetland eddy covariance techniques in a variety of ecosystem across the globe.

Contact Information: Gregory Starr, Department of Biological Sciences, University of Alabama, Tuscaloosa, AL. 35487, Phone: 205-348-0556, Email: gstarr@ua.edu

EFFECTS OF THE LONG-TERM MARINE CLOSURE AND REOPENING OF AN AREA OF THE COASTAL FLORIDA EVERGLADES ON FISHES AND RECREATIONAL FISHERIES

Jennifer Rehage and ***David Stormer***
Florida International University, Miami, FL, USA

Sustainability of coastal marine ecosystems is a worldwide concern due to a variety of anthropogenic impacts including exploitative fishing practices, destructive coastal development and climate change. While the use of spatial marine reserves and marine protected areas has been touted as an effective tool for marine conservation, in practice they have had both proponents and skeptics. Two large coastal embayments in northeastern Florida Bay have been closed to public access, and thus to recreational fishing since the creation of the Crocodile Sanctuary in 1980, but the Everglades National Park General Management Plan recently called for the opening one of the embayments (Joe Bay) to public, non-motorized access and catch and release fishing. The second bay (Little Madeira Bay) to the west of Joe Bay has also been closed for the same period of time as Joe Bay, but will remain closed to public access. This management decision provides a unique opportunity to examine the baseline fish community assemblages of the two bays and recreational fishing conditions of Joe Bay, and how this area may change as a result of opening it to fishing and recreational use.

We hypothesize that the long-term closures of Joe Bay and Little Madeira Bay have resulted in changes in the fish populations, particularly the abundance, composition, body size, distribution, and habitat use of fishes in these embayments, with implications for ecosystem structure and function, and the quality of recreational fisheries provided by this region. To test this, we are comparing the fish community composition in these two bays to a third embayment (Long Sound) just to the east of Joe Bay which has remained open to recreational fishing and recreational use during the closure of Joe Bay and Little Madeira Bay. Because these bays are part of the Everglades National Park, we are employing a new state-of-the-art and non-invasive fish sampling technique using baited underwater remote video stations (BRUVS) to conduct our fishing independent sampling in all three of the embayments. We have also developed a fisheries dependent component that includes a paper-based and online angler survey, a smart-phone application reporting system and a motion activated camera monitoring system for tracking the effect of opening Joe Bay on fishing activity and visitor experiences over time. This reporting system aims to track fishing pressure, angler catches, fish metrics (catch composition, fish size and photos), angler preferences, as well overall visitor experience, motivations and preferences. Preliminary results will be presented.

BIO: Dr. Stormer is a postdoctoral research associate with many years of experience in fish ecology across a broad range of estuarine and coastal systems. At FIU's Southeast Environmental Research Center (SERC), he is dedicated to Florida Everglades restoration.

Contact Information: David Stormer, Department of Earth and the Environment, Florida International University, Miami, FL 33199 USA, Phone: 954-909-1596, Email: dstormer@fiu.edu

A NEW EYE IN THE SKY: A CASE STUDY ON 3D MODELING EVERGLADES RESTORATION PROJECTS WITH DRONE IMAGRY

Daina Stoutenburg[1], *Keanan Bell*[1], *Brent Anderson*[1] *and Brandon Bagoo*[2]
[1]NorthStar Contracting Group, Inc., Tampa, FL, USA
[2]NorthStar Contracting Group, Inc., West Palm Beach, FL, USA

Drone (aka, Unmanned Aerial Vehicle or UAV) technology has impacted the world in a number of ways, providing an effective resource to capture high quality video and aerial imagery. The ability of a drone to reach inaccessible or otherwise cost-prohibitive areas has made it a valuable tool that provides on-demand data that is fast, flexible and affordable. Utilizing drone technology to develop 3D models of environmental restoration projects yields data beneficial to land managers throughout restoration processes to make the best decisions with accurate and up to date data. Used in combination with post-processing software, drone imagery can be upgraded to create accurate 3D models for a myriad of products, including topographic surveys, digital surface models, volumetric calculations and 3D models with photorealistic textures. Since the Federal Aviation Administration has begun approving drone use for commercial applications, the environmental industry is being rapidly advanced by the innovations provided by the use of drone technology.

A case study utilized drone technology and post processing software to collect data from an Everglades restoration project in south Florida and create a 3D model of the project. The goal of the project was to restore historic Everglades hydrologic conditions, improve water quality in the Everglades, and promote a self-sustaining ecosystem. The project included approximately 3,400 acres of citrus grove that were restored to enhance the historical microtopography and hydrology of the site and featured a 2,875 acre flow equalization basin (FEB) to provide additional stormwater retention, treatment and later controlled release. The process of collecting, processing and presenting these data is explored with respect to environmental challenges, processing time, pitfalls and visualization. Converting aerial images to 3D models of project features allows for better imaging, accurate volume calculations and other valuable project management tools. Land managers are able to utilize these products throughout the life of a restoration project as the repeatability of this process is more viable than ever with the practicality of drone technology coupled with suitable post processing power.

The scientific community is easily distracted by the excitement surrounding drones and the new opportunities they have created. Challenges associated with producing advanced data sets with cutting-edge technology are often overlooked. It is important to recognize the planning that is required for each mission. Collecting data to produce a 3D model requires attention to overlap of images, pattern and height of flight, battery life and processing power available. Additional considerations include following safety regulations and laws, location restrictions, weather conditions and forecasts and responsibly monitoring other air traffic. Exploring proper operating procedures and troubleshooting techniques are irreplaceable steps in the data collection process that are integral to each successful mission.

BIO: Mrs. Stoutenburg is a civil and environmental engineer and a licensed remote pilot with a background in managing environmental restoration projects. With the advent of drone technology and regulations in recent years, she has focused on integrating these tools into environmental restoration projects enabling better real time management of projects.

Contact Information: Daina Stoutenburg, NorthStar Contracting Group, Inc., 2760 South Falkenburg Road, Riverview, FL, USA, 33578, Phone: 813-684-4400, Email: dstoutenburg@northstar.com

A NUMERICAL SIMULATION MODEL OF RUPPIA MARITIMA (WIGEONGRASS) AT THE EVERGLADES-FLORIDA BAY ECOTONE: MODEL DEVELOPMENT AND ASSESSMENT OF POPULATION PERSISTENCE

Theresa Strazisar *[1], Christopher J. Madden[2], and Marguerite S. Koch[1]*
[1]Dept. Biological Sciences, Florida Atlantic University, Boca Raton, FL, USA
[2]South Florida Water Management District, Everglades Division, West Palm Beach, FL, USA

Seagrass is an important component of the submerged aquatic vegetation (SAV) community in the Everglades southern estuaries and Florida Bay where it supports high secondary productivity. The goal of our research is to understand factors controlling *Ruppia maritima* L. (wigeongrass), an indicator species at the Everglades-Florida Bay ecotone in support of Everglades restoration and water management strategies. Based on field and laboratory studies (2009-2015), we developed a numerical model (STELLA; iseeSystems, Inc.) that incorporates the *Ruppia* life cycle. We used the model to identify drivers of the species in western and eastern ecotone regions of lower Taylor Slough and to determine conditions that affect short- and long-term population persistence. The model includes seed, seedling, adult, short shoot and reproductive shoots linked by transitions within and among stages. These transitions are modified by relationships with abiotic and biotic conditions, including salinity, light, sediment P and competitor SAV species. Sensitivity analyses were conducted to identify changes in conditions that had the strongest impacts on short and long-term *Ruppia* population dynamics.

Light was the primary driver of *Ruppia* in the western ecotone where it is seasonally reduced to <5% subsurface irradiance (July-Nov). Within five years, a 25% decrease in light resulted in 75% fewer short shoots than current light levels and a 40% light decrease resulted in complete population loss. *Ruppia* was able to persist under low light conditions; however, persistence was dependent on seed production replenishing the seed bank for growth in the subsequent year. Decreases in sexual reproduction resulted in short-term population loss within 3 years as the seed bank was depleted. In the eastern ecotone, sediment P is lower and salinity is highly variable (average yearly salinity 16.2 psu (0.6CV) compared to 22.2 psu (0.2CV) in the west). The modeled population did not increase the first five of the 10 years and maintained notably low shoot densities (<75 m^{-2}). The seed bank was small (<75 seeds m^{-2}) and any reduction in light or nutrients resulted in population loss and inability to regenerate. After six years, the population began to grow; however, a 50% decrease in sediment P or in light resulted in 40% lower seed bank, seedling, adult and short shoot densities, ultimately limiting vegetation production over the 10-year run. Simulations of environmental restoration and sea level rise scenarios enable predictions of *Ruppia* population responses to support management strategies.

BIO: Theresa Strazisar is a postdoctoral researcher at Florida Atlantic University currently collaborating with the SFWMD to create biological models that integrate into management to assist restoration of Everglades habitat.

Contact Information: Theresa Strazisar, Dept. of Biological Sciences, Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431, USA, Phone: 561-297-4221, E-mail: tstraz@gmail.com

USING TELEMETRY TO ELUCIDATE THE ROLES OF ESTUARINE PREDATORS AND LIKELY IMPACTS OF RESTORATION

***Bradley A. Strickland*[1]**, *Michael R. Heithaus*[1], *Phillip Matich*[2], *Adam E. Rosenblatt*[3], *Kirk Gastrich*[1], *and Frank J. Mazzotti*[4]

[1]Department of Biological Sciences, Florida International University, Miami, FL, USA
[2]Sam Houston State University, Huntsville, TX USA
[3]Yale Climate and Energy Institute, Yale University, New Haven, CT USA
[4]Fort Lauderdale Research and Education Center, University of Florida, Davie, FL

Since 2007, the Florida Coastal Everglades Long Term Ecological Research Project has investigated the movements and ecological roles of two of the Florida Everglades largest and most abundant estuarine apex predators, bull sharks (*Carcharhinus leucas*) and alligators (*Alligator mississippiensis*). This work has combined multiple telemetry tools (i.e., passive acoustic and satellite transmitters) with multi-tissue stable isotope analyses to assess how behavior and trophic interactions vary within and among individuals and species and across environmental conditions. Passive acoustic telemetry has been used since 2007 to quantify activity ranges, habitat use, and movement rates of both juvenile bull sharks and adult alligators in the Shark River Estuary (SRE) of Everglades National Park, Florida, USA. In addition, we quantified movements and home ranges of American alligators (n = 30) using satellite tags across a range of environmental conditions in space (from freshwater marshes to coastal estuaries) and time (over 3 years including seasonal variation) in the southern Everglades.

Bull sharks show considerable inter-individual variation in trophic interactions with many individual specializing on one type of resource pool (i.e., marine vs freshwater/estuarine food webs) during their time in the estuary. Despite this, some individuals are flexible and adjust diets to take advantage of prey pulses entering the system from the marsh during the dry season. We also found that bull sharks increase their use of prey-rich marine habitats with age, while continuing use of freshwater/estuarine habitats as refuge from large marine predators. Alligators throughout SRE appeared to use either of three major movement behaviors; remaining in the freshwater marsh exclusively, making short trips from the mid-estuarine zone to the freshwater areas, and making regular long distance travels downstream to exploit prey-rich marine food webs. In the freshwater marsh, alligators exhibited relatively small and stable home ranges. In the estuary, however, we documented high variation among individuals in movements. Some individuals occupied small and stable ranges like those in the marsh while others exhibited considerably greater range size, and more directional movements.

These findings illustrate that animal space use and movement can be highly context-dependent within and among individuals, and understanding this variation is important for elucidating the ecological roles and importance of apex predators. Identifying the relevant temporal and spatial scale of movements for alligators and sharks will allow for the assessment of the potential scale of effects for mobile aquatic apex predators on ecosystem function in forthcoming experimental work. Long-term telemetry studies combined with stable isotope analysis will allow us to elucidate how seasonal and inter-annual variation in conditions affect the behaviors and ecological roles of these apex predator and provide insights into how they will be impacted by future scenarios of climate change, management, and restoration.

<u>BIO</u>: Bradley is a PhD student in the Heithaus Lab at Florida International University studying the ecosystem-level effects of apex predators in the Florida Everglades. He received his MS at Mississippi State University and his undergraduate degree at Berry College in northwest Georgia.

<u>Contact Information</u>: Bradley A. Strickland, Florida International University, Marine Sciences Program, 3000 NE 151st Street, Miami, FL, USA 33181, Phone: 678-322-7059, Email: bstri007@fiu.edu

THE DYNAMIC INTERPLAY BETWEEN FLOODS AND FINANCE: REBUILD VS. RELOCATE DECISIONS CALCULATED WITH RESTORED WETLAND VALUATION

***Kathleen Sullivan Sealey*[1]**, *Ray King Burch*[3] *and Philippe Binder*[2]
[1]University of Miami, Coral Gables, Florida, Gainesville, FL, USA
[2]University Hawai'i Hilo, HI, USA
[3]Independent Financial Analyst, Honolulu, HI, USA

Climate change with Sea Level Rise, now threatens to bring real flooding to coastal homes in South Florida, forcing many residents to face the challenge of rebuilding vs. relocating. Many coastal communities are threatened by development-linked changes in the natural ecosystem that magnify the impact of flooding events on built urban environments (Brody et al., 2011; Nicholls, 2004) . Disasters from coastal storm surges and flooding from failure of human infrastructure (levees or water management structures) will mean large areas of our coastal urban landscape will be re-designed to be more resilient to future flooding events OR people will relocate to safer, higher elevation areas. The relocate decision must include an ecological component on the value-over-cost for restored wetlands. An effective response to flood risk assessment is to employ both natural capital and financial capital, as well as to exploit the links between them. The financial crisis of 2008 showed that sudden change in risk perception in mortgage markets can have long-lasting effects on human systems. Yet, prior to the crisis, financial innovation and complex systems behaviour, combined to create the now-pressing financial and environmental risks. While the need to integrate financial markets into coastal (and environmental) management is increasingly recognized, the difficulty of this task is made greater by the speed of financial innovation, and the obscurity and complexity of its practices.

Research is needed on the possible links in relocate vs. rebuild strategies within the context of the Greater Everglades Restoration Project and the innovation of the Southeast Florida Regional Climate Compact. Although we see some success of public-private partnerships in planning and adapting to sea level rise, there is still the strange disconnect with the cash-and-credit-driven real estate market of south Florida. An overview of how modern finance, particularly the mortgage market, perceives and manages the risk of climate change is critical to the valuation of restored wetlands. We present a case study of how landscapes can be either re-purposed to function ecologically when residents relocate OR rebuilt to reduce the threat of future flooding. The rebuild vs relocate decision requires preparation, outreach education and preparation. What tools will be needed to make these decisions, how can re-building be financed? Residents, governments and insurance-providers need information on the interplay of modern financing of homes and environmental function of changing coastal landscapes all with a view to the real risks from sea level rise.

BIO: Dr. Sullivan Sealey is an associate professor heading the Coastal Ecology Laboratory in the Department of Biology. She has more than 30 years in marine and coastal ecological studies of south Florida and Caribbean islands.

Contact Information: Kathleen Sullivan Sealey, Coastal Ecology Laboratory, Department of Biology, University of Miami, 1301 Memorial Dr. Coral Gables, Florida 33124. 305 284-3013, ksealey@miami.edu

SPATIOTEMPORAL DISTRIBUTION OF SOLAR INSOLATION IN FLORIDA

David M. Sumner[1] *and Michael A. Holmes*[2]
[1]USGS Caribbean-Florida Water Science Center, Lutz, FL, USA
[2]Cherokee Nation Technology Services, Asheville, NC, USA

Solar insolation is a primary determinant of photosynthesis and, in turn, photosynthesis is a primary determinant of carbon sequestration within Greater Everglades landscapes. Carbon sequestration mitigates accumulation of greenhouse gases in the atmosphere while also building or maintaining organic peat-soil topography that offsets sea-level rise. The spatiotemporal distribution of solar insolation in Florida will be discussed based on a 20-year record of high-resolution (2-km and daily) insolation. The compiled database of insolation extends from 1995 to 2015 and is updated and released annually through a partnership between the U.S. Geological Survey Caribbean-Florida Water Science Center, State of Florida Water Management Districts, and private industry.

BIO: David Sumner is the Associate Director (Studies) of the USGS Caribbean-Florida Water Science Center. He has extensive experience in the fields of subsurface hydrology and atmospheric-landscape exchanges of water and carbon.

Contact Information: David M. Sumner, USGS Caribbean-Florida Water Science Center, 4446 Pet Lane, Suite 108, Lutz, FL USA 33559, Phone: 813-498-5025, Email: dmsumner@usgs.gov

DEVELOPMENT OF A SIMPLE VEGETATION INDEX TO MONITOR HABITAT IMPACTS

***Donatto D. Surratt*[1]*, and Rebekah E. Gibble*[2]
[1]Everglades National Park, FL, USA
[2]U.S. Fish and Wildlife Service, FL, USA

Habitat structure is critical to supporting native fauna in the historic Everglades. Nutrient enrichment and long-term hydrologic conditions are major drivers of habitat structure and alterations in both have adversely impacted habitat structure across the Everglades, particularly within the A.R.M. Loxahatchee National Wildlife Refuge. Here, we develop an index of vegetation community fidelity (IVCF) for the Refuge to track habitat structure alterations through time. The IVCF depends on readily available vegetation specific species coefficients of conservation (CC) developed as part of the Florida Floristic Quality Assessment tool (FQA). The FQA assigns CC for each plant species based on their fidelity to natural environmental conditions. The greater the fidelity to natural conditions, the higher the CC score. For example, the plant species *Bacopa carolina* is assigned 8 of 10 for a CC score, which suggest the plant has a high affinity for low impact areas of the Everglades, while *Typha spp*. Is assigned a CC of 2 reflecting high affinity for highly impacted areas. The IVCF, for the Refuge, combines CC scores for observations of seven sensitive species at individual water quality sampling location with a normalized qualitative density observation (0:absent, 1: <=10% cover, 2: <=75% cover, and 3: >75% cover). Data collected at 33 monitoring stations within the Refuge between November 2010 and April 2016 are used for evaluation in this analysis. We use the IVCF scores to identify the quality of habitat with scores at individual stations below 5 having a high impact level, 5 to 14 having a moderate impact level, and greater than 14 having a low impact level. Spatially, the quality of habitat estimated using the IVCF shows a gradient of increasing quality from the perimeter of the marsh near the canal into the marsh interior. Most stations within the first 2.5 km into the marsh from the canal exhibit highly impacted vegetation community structure. Most stations beyond 2.5 km into the marsh exhibit moderate to low impact levels. Temporally, when examining the Refuge as a whole, mean index values by water year (May through April) remain at the moderately impact area from WY2011 through WY2016. Along the STA1W transect, regression analysis shows stations within 2.2 km from the canal are significantly improving in habitat quality. However, along the STA1E transect, only one stations (LOXA138, 2.1 km into the marsh) shows significant change and it is degrading in quality. The IVCF approach provides estimates of habitat quality that are consistent with conventional wisdom based on decades of evaluation on the Refuge. Spatially, the estimated habitat quality matches with decreasing nutrient and mineral gradients from the canal into the marsh interior. Based on the IVCF over the analyzed period, there has been little to no changes in vegetation community structure when considering the Refuge as a whole. The IVCF approach can easily be expanded to other areas of the Everglades using the relatively inexpensive method of data collection. As resources for water quality and ecosystem habitat monitoring continue to dwindle nationwide, the value of the IVCF approach to assessing ecosystem integrity becomes highly valuable.

BIO: Dr. Surratt is a senior ecologist with almost 20 years of biogeochemical evaluation for wetland and coastal ecosystems. He has extensive experience with wetland water quality and restoration. Dr. Surratt presently provides guidance for and performance of data analysis and technical summaries for water quality issues surrounding Everglades Restoration.

Contact Information: Donatto Surratt, Everglades National Park, National Park Service, c/o 10218 Lee Road, Boynton Beach, FL 33473, Phone: 561-735-6003, Fax: 561-735-6008, Email: donatto_surratt@nps.gov

NUMERICAL MODEL FOR SHORT-TERM FORCASTING OF EVERGLADES HYDROLOGY USING A CURRENT CONDITIONS WATER-LEVEL NETWORK

Eric Swain *and Melinda Lohman*
U.S. Geological Survey Caribbean-Florida Water Science Center, Davie, FL USA

Numerical models are commonly used to predict future hydrologic conditions but the uncertainties in results increase dramatically as the simulation period increases. Often short-term simulations on the order of days can be useful to answer immediate water-management questions but are generally not available due to the time required to obtain and implement initial conditions of the hydrologic system. Hydrologic monitoring networks and a coupled groundwater/surface-water model can provide near-term projections of hydrologic response.

Daily measured water levels in the Greater Everglades are incorporated into the Everglades Depth Estimation Network (EDEN), an integrated set of tools that utilizes water-level gages, interpolation methods, and other analyses to represent hydrologic data across the freshwater part of the Greater Everglades. EDEN provides initial water-level conditions for a hydrologic model, and same-day values are available. The Biscayne and South-Eastern Coastal Transport (BISECT) model was developed to represent surface-water and groundwater hydrology in Everglades National Park and the Miami eastern urban area. The surface water is represented with a hydrodynamic formulation so it is ideal for the dynamic inland and coastal hydrology of the Everglades. Water-level initial conditions are defined as an array of input values, which can be assigned from the current EDEN water-level surface. Usually a "warm-up" period is required at the beginning of a model simulation, during which the hydrologic formulation equilibrates to a realistic configuration, but using the current water levels determined from the field-station network reduces the need for such a period.

The short-term forecast time series must reflect the meteorological and management conditions expected for the period. Rainfall and evapotranspiration can be defined based on seasonal average values or for a specific event of interest (e.g., a storm). Water deliveries at model boundaries also can be defined as seasonal averages or as specific events (drought or flood). Other initial conditions, such as the salinity distribution, are more difficult to specify as they are not as well defined by known field values.

In order to use this predictive model tool, which integrates BISECT and EDEN, the user need only define the starting day, the length of the simulation, and the projected or scenario meteorological/management conditions for the simulation period. The model simulates projected water-levels, flows, and salinities for surface water and groundwater. This prediction model tool allows water managers to examine likely short-term scenarios and base decision-making on physics-based computational methods rather than rule-of-thumb approaches.

BIO: Dr. Swain is a research hydrologist at the Caribbean Florida Water Science Center office in Fort Lauderdale Florida. He has specialized in the development of numerical models of surface-water/groundwater flow as well as statistical analysis of hydrologic parameters and methodology for determining field parameters.

Contact Information: Eric Swain, U.S. Geological Survey Caribbean-Florida Water Science Center, 3321 College Avenue, Davie, FL, USA 33314, Phone: 954-377-5925, Email: edswain@usgs.gov

THE INFLUENCE OF ALTERED FLOW REGIMES ON AQUATIC ECOSYSTEM METABOLISM IN AN EVERGLADES MARSH

Erik Tate-Boldt[1], *Sue Newman*[1], *Colin Saunders*[1], *and Chris Hansen*[1,2]
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]Florida International University, Miami, FL, USA

The objective of this study is to determine the effects of restored sheet-flow on Everglades aquatic ecosystem metabolism within the Decompartmentalization Physical Model (DPM) project. The DPM is a landscape-scale field test evaluating hydrologic and biological responses to flow treatments, including low flow (baseline) and high flow (impact) conditions. The DPM uses an inflow structure (S-152) consisting of 10 gated culverts on the L67A to provide high flow velocities into an area between the L67A and L67C levees. Starting in 2012, dissolved oxygen (DO) and other water quality parameters were measured at 10 sites, including slough and sawgrass ridge habitats, within the DPM study area using water quality sondes. Sondes were deployed continuously for 5 days per month and gross and net primary productivity, as well as aquatic respiration, were calculated from diurnal changes in DO. We hypothesized that sites with the high flow conditions would have increased productivity and respiration as compared to low flow sites. Previous studies have shown that increased water velocity decreases the diffusive boundary layer of submerged aquatic vegetation (SAV), thus increasing the diffusive rates of nutrients and carbon dioxide into the plant. This in turn increases oxygen production during photosynthesis. However, preliminary data suggest that while DO is increased in sloughs during periods of increased flow, aquatic ecosystem metabolism decreases. This may be caused by several factors: 1. increased flow physically pushes the detached SAV and periphyton to the slough edges and into the ridge thus decreasing the active photosynthesis in the slough; 2. other studies show that mechanical bending stress applied to some species of SAV decreases the photosynthetic rates in the plant; 3. the increased water velocity breaks apart and damages SAV and periphyton decreasing photosynthesis within the slough; or 4. export of dissolved oxygen by the increased flows out of the slough into the ridge. The relative importance of these alternative explanations, and the implications of altered slough metabolism for restoration at the landscape level will be discussed.

BIO: Erik Tate-Boldt is a wetland ecologist with the Marsh Ecology Research Group of the South Florida Water Management District and currently works on the implementation of scientific research on wetland biogeochemistry and ecology to support the Everglades restoration process and water management operational decisions.

Contact Information: Erik Tate-Boldt, Everglades Systems Assessment Section, South Florida Water Management District, 8894 Belvedere Road, West Palm Beach, FL, USA 33411, Phone:561-753-2400 ext. 4650, Email:etate@sfwmd.gov

GETTING IN TOUCH WITH YOUR INNER MCGUYVER: LESSONS LEARNED FROM FIELD RESEARCH IN AQUATIC ECOSYSTEMS

***Kyle L Thayer**, Lyn A Gettys and Ian J Markovich*
University of Florida FLREC, Davie, FL, USA

Conducting field research in aquatic ecosystems can be challenging because it is a niche market with limited specialized tools and equipment. Also, standard plot establishment protocols that work well in upland systems are not well-adapted to an environment that is influenced by flow, changing water depths, alligators, and other factors. I will outline some of the “lessons learned” while conducting field research under these challenging conditions and will also provide details about novel devices we have developed for experiment monitoring and data collection.

BIO: Kyle Thayer is an Agricultural Assistant in Dr. Lyn Gettys’ Aquatic Plant Science Lab at the University of Florida FLREC. He has an Associate’s degree from Palm Beach State College and is working on a bachelor’s degree. He supervises students and lab personnel while conducting aquatic plant research.

Contact Information: Kyle Thayer, University of Florida IFAS FLREC, 3205 College Avenue, Davie, FL, USA 33314, Phone: 561-339-6573, Email: kthayer25@ufl.edu

SETTLING AND ENTRAINMENT PROPERTIES OF STA PARTICULATES

*Leonard J. Scinto[1], **Serge Thomas[2]**, David C. Fugate[2], Shimelis B. Dessu[1], David W. Perkey[3], René M. Price[1], S. Jarrell Smith[3]and Colin J. Saunders[4]*

[1]Florida International University (FIU), Miami, FL, USA
[2]Florida Gulf Coast University (FGCU), Fort Myers, FL, USA
[3]U.S. Army Corps of Engineers, Engineer Research & Development Center (AERDC), Vicksburg, MS, USA
[4]South Florida Water Management District (SFWMD), West Palm Beach, FL, USA

FIU, in partnership with FGCU and the AERDC has recently been contracted by the SFWMD to lead a study focusing on the characteristics of the particulate settling, resuspension and overall sediment entrainment in Stormwater Treatment Areas (STAs) 2 and 3/4 under stagnant, low, and high flows.

These STAs receive surficial water from canals draining the Everglades Agricultural Area (EAA) located south of Lake Okeechobee. STAs are flow-through constructed operated to reduce phosphorus (P) via various mechanisms involving i) plant and microbial uptake, ii) biologically mediated chemical changes enhancing P sequestration (e.g. pH change yielding P co-precipitation with calcite), iii) particulate settling and entrapment within the vegetation, iv) chemical (e.g. P sorption), overall resulting in P-storage via accretion. Despite undeniable P removal successes with over 85% reduction in P load in recent years, additional efforts are necessary to achieve stringent regulatory limits, including finding ways to reduce particulate P at the outflow which is generally 50% of outflow total P.

This investigation, which is part of a larger study to quantify and determine the nature of internal P cycling in the STAs, aims to assess the i) temporal and spatial variation in velocity by making cross sectional flow velocity transects along the flow ways, ii) particle settling rates by size and TP contents, iii) threshold velocity/critical shear stress to remobilize various sediment class sizes and TP contents and entrain them downstream and iv) the correlation between particulate load and hydrologic/weather conditions. These various goals involve field and laboratory studies using field-sampled materials.

Preliminary results show that high velocity (>2m/s) were periodically observed especially in remnant ditches (i.e. privileged scoured areas) and that sediment/floc is constantly remobilized in the water column from settled particulate. The use of underwater time-lapse cameras over sediment plate traps asserts this constant remobilization as well as captured sloughed periphyton from the surrounding biological environment and sediment/floc bioturbation from fishes. Suspended particulates follow a diurnal pattern associated with afternoon winds. In addition to the wave effect, winds were responsible for as much as 40% of the variability in mean flow magnitudes. Suspended sediment and shear stress peaked in late afternoons. Critical shear stresses for resuspension of sediment were significantly higher than those for deposition, so that high suspended sediment concentrations persisted long after the winds stopped. The erodibility of the sediment from sampled cores (i.e. as measured with a SedFlume and a GUST chamber) was quite consistent over the various sediment collected from the inflow to the outflow in all STAs. The sediment traps deployed point out that the settled particle size is smaller from inflow to outflow.

<u>BIO</u>: Dr. Thomas is an Assistant Professor with over 20 years of experience dealing with the ecological study and the remediation of various culturally eutrophied subtropical shallow hydrosystems. Such a remediation involves especially the use of constructed wetlands (STAs) as well as stormwater retention/detention ponds in Florida.

<u>Contact Information</u>: Serge Thomas, Florida Gulf Coast University, 10501 FGCU Blvd. S., FL, USA 33965, Phone: 239-590-7148, Email: sethomas@fgcu.edu

WHY HAS IT BEEN TAKING SO LONG TO PERMIT NEW WEED BIOCONTROL AGENTS?

Bob Tichenor
USDA APHIS PPQ, Riverdale MD, USA

USDA APHIS Plant Protection and Quarantine writes the permits to allow release and study of new weed biocontrol agents that are non-indigenous to the US. This is an historical role for APHIS for many decades. However beginning March 2011 and until May 2016, no new agents had been permitted. This was not for lack of petitions, and the process at APHIS and our willingness to permit new agents was questioned. There is a review process prior to issuing a permit, referred to as the environmental compliance process, which is presented in flow chart format. APHIS must determine two things regarding expected environmental impact of the release: that there is no adverse effect expected to any Threatened and Endangered Species and so significant Impact to the environment. These are rooted in the Endangered Species Act (requires consultation with the Fish & Wildlife Service), and the National Environmental Policy Act (requires preparation and publication of an Environmental Assessment). Details of the current processes are given, including recent changes, and highlights regarding preparing for the environmental compliance process.

Contact Information: Robert Tichenor, Entomologist, USDA APHIS PPQ, Pests, athogens and Biocontrol Permits, 4700 River Road, Unit 133, Riverdale, MD 20737, Phone: 301-851-2198, Email: Robert.H.Tichenor@aphis.usda.gov

INDIRECT EFFECTS - FOOD WEBS IN BIOLOGICAL CONTROL

Philip W. Tipping
USDA-ARS, Davie, FL, USA

Arthropod food webs in natural systems are dynamic and complex, making quantitative analysis challenging. Generalist predators in particular may engage in complicated predator-predator interactions like cannibalism and omnivory, resulting in poorly defined trophic levels. In addition to not interacting at all, predators may attack and kill each other, they may influence each other's foraging, or they may influence prey susceptibility for other predators. Intraguild predation (IGP) is widespread in food webs with 58-87% of species engaged in this phenomenon in 113 studied food webs. Less complex food webs are often present on non-native plants, especially on those that were introduced without specialist herbivores and have become weedy. Biological control programs that target weeds with intentional introductions of host-specific herbivores may initiate or contribute to existing food webs by providing subsidies to generalist predators. Critics of biological control argue that employing this tactic can influence food web interactions unpredictably, resulting in indirect effects that range from apparent competition to risks to human health.

Several studies have found that food web interactions are generally weak in natural systems with a few strong interactions. Despite this, there is no single theoretical generalization that accurately predicts community-level effects for every system or the impacts of alternate prey like biological control agents on shared prey. A partial food web that included two weed biological control species on the invasive tree *Melaleuca quinquenervia* and their associated generalist predators was examined by monitoring insect densities every two weeks for a year. A theoretical path model was developed that described directional relationships among predators and the two agents, *Boreioglycaspis melaleucae* and *Oxyops vitiosa*. Path analysis indicated that the model provided a good fit to the observed data and identified strong effects of Coccinellidae on *B. melaleucae* and Pentatomidae on *O. vitiosa*. The other six predator groups exhibited little or no influence on the agents. Relatively low r^2 values within the path model indicated that predators were more likely to be influencing each other (though IGP) than the agents. There were numerous observations of IGP events during the course of these studies and the path diagram illustrated how many potential predator-predator interactions were present compared with predator-herbivore interactions.

The potential community level outcomes from biological control programs deserve scrutiny and evaluation but their ultimate effects, especially potential indirect effects, should be given their proper weight. It should be noted that indirect effects are also widespread in natural systems, unique to their own communities, and are dynamic processes whose ecological significance will remain open to interpretation. Those studies that have documented or posited indirect effects have been limited in scope, timing, and scale and their ecological significance were likely negligible compared with the host of inevitable and elemental direct and indirect effects created by the wholesale transformation of ecosystems by invasive plants.

BIO: Dr. Tipping is a research entomologist with 30 years of experience in the biological and integrated control of insect and weed pests. In Florida, he has worked on developing and evaluating biological control agents for *Melaleuca quinquenervia, Salvinia molesta, S. minima, Eichhornia crassipes, Pistia stratiotes,* and *Triadica sebifera*.

Contact Information: Philip W. Tipping, Ph.D., Research Leader, USDA-ARS Invasive Plant Research Laboratory, Davie, FL 33314, Phone: 954-475-6547, Email: philip.tipping@ars.usda.gov

ROLE OF LANDSCAPE CONSERVATION COOPERATIVES IN EVERGLADES RESTORATION

Steve Traxler[1], *Todd Hopkins*[1], *Beth Stys*[2]
[1]US Fish and Wildlife Service, Vero Beach, FL, USA
[2]Florida Fish and wildlife Conservation Commission, Tallahassee, FL, USA

With the signing of Secretarial Order No. 3289, the Department of the Interior launched the Landscape Conservation Cooperatives (LCCs) to better integrate science and management to address climate change and other landscape scale issues. By building a network that is holistic, collaborative, adaptive, and grounded in science, LCCs are working to ensure the sustainability of our economy, land, water, wildlife, and cultural resources.

The 22 LCCs collectively form a network of resource managers and scientists who share a common need for scientific information and interest in conservation. The Peninsular Florida LCC (PFLCC) consists of over 30 stakeholders from federal, state, and local governments along with Tribes, non-governmental organizations, universities, and interested public and private organizations. Our partners work collaboratively to identify best practices, connect efforts, identify science gaps, and avoid duplication through conservation planning and design.

The PFLCC has a number of projects which vary in scale from a blueprint piece of the Southeastern Conservation Adaptation Strategy (SECAS), setting statewide conservation targets to develop a landscape conservation design (LCD) for Florida, to smaller scale projects like the Florida Keys T&E adaptation strategy, Big Bend adaptation LCD, and the Southwest Florida resilient Land and Water project and LCD. Each of these projects leverages a wide variety of partners and will help contribute to conservation and restoration actions in Florida. In cooperation with US Fish and Wildlife Service, many plans will be implemented on National Wildlife Refuge lands throughout the landscape, making a significant contribution to landscape conservation. This talk will highlight these projects and some of the tools being used and developed by the PFLCC.

BIO: Steve Traxler works for the USFWS as a Fish and Wildlife Biologist. Steve has been working on Everglade's restoration since 1996. Since 2012, Steve has been coordinating science for the Peninsular Florida Landscape Conservation Cooperative. Steve's other projects include Everglades RECOVER and climate change.

Contact Information: Steve Traxler, US Fish and Wildlife Service, Vero Beach, FL USA 32960, Phone: 772-532-6537, Email: steve_traxler@fws.gov

NON-NATIVE FISH AND EVERGLADES RESTORATION: AN UNEXPECTED CHALLENGE TO RESTORING AN ICONIC ECOSYSTEM

Joel C. Trexler[1] *and Jeff Kline*[2]
[1]Florida International University, North Miami, FL USA
[2]Everglades National Park, Homestead, FL, USA

Everglades aquatic communities support apex predators that define its iconic status. Wading bird abundance is greatly reduced in the modern ecosystem and they often experience years of low nesting success because of food limitation. Everglades restoration assumes that water delivery is the source of these losses and that apex predators will rebound if historical hydropatterns are recovered. The Everglades is experiencing marked invasion by non-native plants and animals, and in aquatic habitats a diversity of fishes have become established and at times reach high numbers. The impact of these invasions on proposed benefits of hydrological restoration is unclear. The objective of this presentation will be to evaluate if these invaded aquatic communities still provide historical function of providing high-quality prey resources for apex predators. We will use long-term data records to evaluate the impacts of invasive species on fish biomass and community dynamics at the landscape scale. We have developed statistical models that predict fish biomass and community structure as a function of hydrological conditions, parameterized with data collected before the invasions of African Jewelfish (*Hemichromis letourneuxi*), Asian Swamp Eels (*Monopterus albus*), and Spotfin Spiny Eels (*Macrognathus siamensis*). We will use these predictions to evaluate community structure since the invasions and document their impacts on community function.

African Jewelfish increased in numbers in the Shark River Slough (SRS) following a 2010 cold snap and were present at ~50% of monitoring sites by 2012; their relative abundance exceeded 15% of all fishes collected at 70% of study sites in 2014. Asian Swamp Eels and Spotfin Spiny Eels also increased in numbers over the same period in Taylor Slough (TSL) but were absent or incidental elsewhere through 2015. In 2012, the density of native fish in SRS was less than expected based on hydrology in pre-invasion models, though the density of all fish (native plus non-native) was similar to predicted. In TSL, there is no evidence of decreased density of native fishes linked to the two invasive species that are now common there. The current data do not indicate that fish invasions have altered the food production system that underlies major features of the Everglades in the public's view, though community structure has been altered in irreversible ways. Continuing research is needed to determine if this new community can be managed in a way to sustain iconic values of the Everglades.

<u>BIO</u>: Joel Trexler is a Professor of Biological Science at Florida International University with 25 years of experience planning, designing, and implementing Everglades restoration monitoring and research projects. He has extensive experience with analysis of population and community dynamics in aquatic environments.

<u>Contact information</u>: Joel Trexler, Department of Biological Science, Florida International University, 3000 NE 151st Street, North Miami, FL, USA 33181, Phone: 305-348-1966, Email: trexlerj@fiu.edu

CARBON CYCLE SCIENCE IN THE FLORIDA COASTAL EVERGLADES: RESEARCH TO INFORM LANDSCAPE MANAGEMENT

Tiffany G. Troxler[1], *Evelyn E. Gaiser*[1], *Jordan N. Barr*[2], *Josh Breithaupt*[3], *Edward Castaneda*[1], *Sean P. Charles*[1], *Carlos Coronado*[4], *Stephen Davis*[5], *Jose Fuentes*[6], *Stephen Kelly*[4], *John S. Kominoski*[1], *Christopher J. Madden*[4], *Sparkle Malone*[7], *Viviana Mazzei*[1], *Steve Oberbauer*[1], *Fred H. Sklar*[4], *Shelby Servais*[1], *Joseph Donny Smoak*[3], *Joseph Stachelek*[8], *Greg Starr*[9], *and Benjamin J. Wilson*[1]

[1] Southeastern Environmental Research Center and Department of Biological Sciences, Florida International University, Miami FL, USA
[2]Elder Research, Charlottesville, VA, USA
[3]University of South Florida, St. Petersburg, FL, USA
[4]Everglades Systems Assessment Section, South Florida Water Management District, West Palm Beach FL, USA
[5]Everglades Foundation, Miami, FL, USA
[6]University of Pennsylvania, Charlottesville, VA, USA
[7]USDA Forest Service, Fort Collins, CO, USA
[8]Michigan State University, East Lansing, MI, USA
[9]University of Alabama, Tuscaloosa, AL, USA

Organic carbon (C) storage in peat soils is critical to maintaining wetland elevation and coastal wetland stability. As sea level rises, coastal freshwater and brackish wetlands like the southern coastal Everglades are being exposed to increased duration and spatial extent of inundation and salinity, which can affect soil C balance through soil redox potential, microbial respiration, and the intensity of osmotic stress to vegetation. The term “peat collapse” has been used to describe a relatively dramatic shift in soil C balance, leading to a rapid loss of soil elevation, and culminating in a conversion of vegetated freshwater marsh to open water. Evidence of freshwater peat collapse has been observed in lower Shark River Slough, Everglades, Florida, suggesting that this process is ongoing and may be affected by factors of reduction in freshwater discharge, recent storm surges (e.g., Hurricane Wilma), sea level rise, and possibly fire. The process has been documented to varying degrees across the U.S., contributing to instability of coastal marshes and degradation of important ecosystem services including fisheries habitat, shoreline stabilization, and C sequestration provided. In field and mesocosm experiments, we are increasing salinity in freshwater and brackish marshes of the southern coastal Everglades, to investigate auto- and heterotrophic mechanisms hypothesized to contribute to peat collapse. Long-term research on primary productivity illustrates interactions with water management and climate to influencing coastal wetland carbon cycling.

Evidence from our previous experiments with mangrove peats showed predicted shifts in soil redox and enhanced C loss from soils exposed to increased salinity. Results from our marsh studies show reduction in phosphorus and increase in C acquisition by soil microbes in brackish marshes, which become stronger C sources during the dry season than freshwater marshes. Long-term field research illustrates the interaction of water management and soil carbon stability, linking carbon and water management across the landscape. Our experimental studies will elucidate plant-soil mechanistic responses to elevated salinity that are hypothesized to stimulate loss of soil C in the coastal Everglades. Our long-term research provides the landscape context for how water management drives primary productivity, vegetation change and ecosystem carbon cycling.

BIO: Dr. Troxler directs the Sea Level Solutions Center at Florida International University, a state university center that focuses on advancing knowledge, decision making and actions toward mitigating the causes and adapting to the effects of sea-level rise. She is a research scientist with expertise in coastal and wetland ecosystem science. Some of her projects include collaborative research that examines the effects of saltwater inundation on Everglades coastal wetlands, monitoring management actions associated with Everglades restoration and advancing interdisciplinary urban solutions to sea-level rise.

Contact Information: Tiffany G. Troxler, Southeast Environmental Research Center and Department of Biological Sciences & Sea Level Solutions Center, Florida International University, 11200 SW 8th Street, OE 148, Miami, FL 33199 USA, Phone: 305-348-1453; Email: troxlert@fiu.edu

DECISION ANLALYSIS FOR THE OPTIMAL CONTROL OF MELALEUCA

***Bradley Udell*[1]**, *Mathieu Bonneau*[1], *Julien Martin*[2], *Fred Johnson*[2], *Christina Romagosa*[1]
[1]University of Florida, Dept. of Wildlife Ecology and Conservation, Gainesville, FL, USA
[2]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

Florida spends millions of dollars annually on the control of invasive exotic plants such as Hydrilla (*Hydrilla verticillata*), Brazilian pepper (*Schinus terebinthifolius*), and melaleuca (*Melaleuca quinquenervia*). These plants invade native ecosystems, displacing native species, altering nutrient cycling and ecosystem function, and ultimately lead to biotic homogenization. Melaleuca in particular was introduced intentionally as a potential timber source, and spread rapidly throughout South Florida, including the Florida Everglades. Management efforts appear to have stemmed the rapid spread of melaleuca in recent years; however, the problem requires vigilant and costly management. Thus, this problem is a prime candidate for decision analysis, to seek improvement in the efficiency of management, minimizing ecological costs while also limiting costs of management. Melaleuca is managed in part by using aerial surveys to detect areas it has invaded, then sending ground crews to spray herbicide and remove it. The introduction of a biocontrol agent has also proved promising in controlling the spread of melaleuca. However, conducting surveys, sending crews, and the biocontrol program have associated costs.

We present 2 approaches seeking to improve the control efforts of melaleuca. The first is based on minimizing the occurrence probability of melaleuca in a study area for a set budget. To start, we apply hidden Markov random fields to aerial survey data to estimate the occurrence probability of melaleuca in sites in a landscape, accounting for both false positive (misclassification) and false negative rates (failed detection). After creating a map of occurrence probabilities, and a map of the cost of management in each location, we apply linear integer programming to determine the optimal set of locations which should be treated to minimize melaleuca occurrence for a fixed budget. This approach balances the cost of sending crews to locations with our belief they will be contain melaleuca. This approach has limitations however, in that it is based on a static pattern of occurrence, and does not account for the difference in efficacy or costs of different types of management. The second approach links management actions with dynamic models of melaleuca spread, accounts for the possibility of recolonizations, and also improves understanding of how different types of management affect the control of melaleuca. This approach quantifies the links between different management actions and melaleuca survival and spread. It then utilizes this information to more effectively control melaleuca, while treating the spread as a dynamic problem. We discuss the relative utility of both approaches, and when one type is more appropriate than another. We note that both approaches demonstrated here can be easily transferred and applied to control efforts of other invasive plants and vertebrates of concern.

<u>BIO</u>: Bradley Udell is a PhD student at the University of Florida studying the optimal control of invasive species. His work combines statistical estimation, process based modeling, and optimization approaches to solve pressing conservation management problems; which are guided by perspectives in theoretical, applied, and landscape ecology.

<u>Contact Information</u>: Bradley Udell, Florida Cooperative Fish & Wildlife Research Unit, Department of Wildlife Ecology and Conservation, Institute of Food and Agricultural Sciences, Bldg. 810, PO Box 110485, Gainesville, FL 32611-0485. Phone: (352) 846-0534.
Email: bradjudell@ufl.edu

TESTING INHIBITOR REMOVAL FROM ENVIRONMENTAL DNA (EDNA) SAMPLES FOR THE DETECTION OF RARE OR CRYPTIC SPECIES IN THE GREATER EVERGLADES ECOSYSTEM

Amelia Ulmer[1, 2]*, Gaia Meigs-Friend*[1]*, Jason Ferrante*[1]*, and Margaret Hunter*[1, 2]
[1]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, Florida, USA
[2]University of Florida, Gainesville, FL, USA

Environmental DNA (eDNA) is a new technique in conservation genetics where genetic material is extracted from environmental samples, such as soil or water. Environmental DNA provides a novel way to detect and study rare or cryptic species. The majority of eDNA studies utilize water samples, which can be rich in tannins and phenolic compounds from vegetation and soil. Water collected the greater Everglades ecosystem are particularly rich in these organic compounds. These compounds inhibit PCR reactions either by binding to DNA polymerase and blocking its function, or by inactivating DNA polymerase during oxidation. The use of inhibitor removal kits can be expensive, time consuming, and may result in the loss of low quantities of DNA. Reducing inhibition is crucial for the accurate quantification of genetic material and calculation of occurrence and detection estimates. Here, we tested and developed a new protocol for isolating eDNA from filtered water samples that reduces the amount of inhibition without the use of inhibitor removal kits. Our control technique consisted of preserving the filters in 2 mL of Longmire's buffer and extracting DNA using a traditional Phenol:Cholorform:Isoamyl Alcohol (PCI) protocol. The first experimental technique involved preserving the samples in Longmire's buffer followed by a Cetyl trimethylammonium bromide (CTAB) buffer step and a clean-up with Cholorform:Isoamyl. The second experimental technique involved replacing the Longmire's buffer with CTAB buffer, containing PVP, and β-mercaptoethanol, and extracting DNA with the traditional PCI protocol. PVP and β-mercaptoethanol are specifically known to break down tannins and phenolics. This final method was found to be the best at reducing inhibitors, thereby conserving DNA and reducing time and cost. This is the one of the first experiments that has tested the utility of different inhibitor removal compounds on eDNA extracted from water samples. This technique is especially helpful for studying eDNA samples from the Everglades ecpsystem, and other regions throughout the southern U.S., and will allow for improved detection of invasive species such as the Burmese python (*Python bivittatus*) and snakehead (*Channa marulius*).

BIO: Amelia Ulmer is an undergraduate student in the University of Florida's Wildlife Ecology and Conservation program. She has been working as a student contractor with the USGS WARC Conservation Genetics Laboratory for three years. Her lab work focuses on using eDNA to detect rare and cryptic species.

Contact Information: Amelia Ulmer, Wetland and Aquatic Research Center, US Geological Survey, 7920 NW 71st Street, Gainesville, FL 32653 USA, Email: aulmer@usgs.gov

INFLUENCE OF C-111 SPREADER CANAL ON GROUNDWATER LEVELS IN THE C-111 BASIN AND TAYLOR SLOUGH AREA, MIAMI-DADE COUNTY, FLORIDA

Kalli Unthank *and Rene Price*
Florida International University, Earth and Environment

Canalization of the South Florida landscape has drastically altered the amount and direction of surface and groundwater flow). An area that is especially affected by the change in water supply is the Taylor Slough and C-111 basin, which has seen decreased water levels compared to pre-canalization. In order to rehydrate the area, a spreader canal was constructed in the C-111 canal to redirect water back into Taylor Slough.

This study was conducted to determine the influence of the spreader canal on water levels and the direction of water flow in the vicinity of the canal from before and after the construction (April 2012). After selecting 22 wells that represent the study area, daily water level data from September 2008 to September 2016 was obtained from DBHYDRO. Water levels were mapped using the Empirical Bayesian Kriging method in GIS software. Water levels maps were made for seasonal (wet and dry) averages. The water levels were also graphed against time to determine the spreader canal's effect on the seasonal high and low water levels.

From a graph of water levels over time, the maximum and minimum water levels appear to be dampened after the construction of the spreader canal (April 2012). After comparing the maps of seasonal averages from before and after the spreader canal construction, it appears that the canal has a greater effect on groundwater flow directions in the dry season. Additional analysis is needed to determine the overall influence of the C-111 canal on water levels and flow into Taylor Slough.

Bio: Kalli Unthank is a second year PhD Student in the Department of Earth and Environment at Florida International University. Her research interests are in groundwater hydrology, water quality, and agricultural contamination of ecosystems.

Contact Information: Kalli Unthank, Florida International University, 11200 SW 8th St, Miami, FL, 33199, Phone: 502-418-4388, Email: kunth001@fiu.edu

PLANT COMMUNITY CHANGES INTERMEDIATE ON THE HALOCLINE BETWEEN MANGROVE AND UPLAND HABITAT OF THE NATIONAL KEY DEER REFUGE 1990-2013

***Craig van der Heiden*[1]**, *James Johnson*[1,2]
[1]Institute for Regional Conservation, Delray Beach FL, USA
[2]University of Georgia, Athens GA, USA

Sea Level rise, salt water inundation, and hurricane driven disturbances are known to have detrimental effects on coastal vegetation, and the distribution of plant communities. Small oceanic islands like the islands of the Florida Keys are drastically affected by these perturbations as they lack the buffering ability of large land masses. In this study, our goal is to compare plant communities intermediate on the halocline between mangrove and upland habitat and make direct comparisons with current data and those collected 10 and 20 years previously. In particular, we are interested in the response of rare and endangered plant species to sea level rise and storm surge. Our data indicate that rare and endangered plants have significantly declined over the past 20 years. The results suggest drastic changes in the ecosystem as salt tolerant plant species dominate with a loss of biodiversity and rare plant species.

BIO: Dr. van der Heiden is a conservation biologist with extensive experience in protecting and preserving native flora and fauna.

Contact Information: Craig van der Heiden, Institute for Regional Conservation, 100 East Linton Blvd, Suite 302B, Delray Beach Fl 33483, email: craig@regionalconservation.org

FIFTEEN YEAR FOLLOWUP SURVEY TO ASSESS THE PROGRESS OF A CYPRESS-POND APPLE TREE PLANTING PROJECT IN THE LOXAHATCHEE NATIONAL WILDLIFE REFUGE, BOYNTON BEACH, FL USA

Peggy VanArman[1],Kyle Holly[1], Trinity Livingston[1], Austin Peightel[1],David Periard[1], Catherine Wiersma[1], and ***Joel VanArman[2]***

[1]Palm Beach Atlantic University, West Palm Beach, FL USA
[2]Environmental scientist (retired) West Palm Beach, FL, USA

Cypress swamps (domes and strands) formed large forested parts of the Everglades ecosystem, until the 1900s, when a majority of cypress was cut to furnish wood for buildings and commercial interests. As part of Everglades ecosystem restoration and management, much work remains to assess the value of wetland tree plantings. The positive influences of cypress dominated forested wetlands include the maintenance of species and habitat diversity, resource conservation, wildlife corridors, and reduction of pollution. These positive influences are just a few examples of why it is important to maintain cypress wetlands in the Everglades system.

A pilot project to restore a cypress swamp community was conducted in 2001 by planting cypress, maple, and pond apple trees in impoundment B-3 (Arthur R. Marshall National Wildlife Refuge, Boynton Beach Florida) (ARM-Lox). In June 2007, a follow-up survey was conducted to monitor growth and survival of those trees. Growth (height above ground level), diameter at breast height (dbh) and number of trees (survival) of the three tree species were measured along six belt transects established in the 6.5 acre site. An additional inspection was conducted in March 2016 to measure continued growth and survival.

Growth and survival data for cypress trees from the 2016 survey were compared to data from the original planting in 2001 and the 2007 study. Data analyses indicated that significant growth occurred in surviving cypress trees from 2007 to 2016, survival rates were above 75% in most plots, and it appears that some recruitment has occurred. No maple trees were observed, and only a few small pond apple trees were found.

Success of the restoration was largely impacted by the inability to regulate water levels, resulting in erratic changes in hydroperiods and in extended flooding throughout the year. Results of this study emphasize the importance and need for periodic monitoring of tree plantings and adaptive management to control hydroperiods in the replanted systems. Additionally, it is important to assess hydroperiods in the study area prior to planting, to determine whether conditions are adequate to promote growth and survival.

BIO: Joel VanArman retired as a chief environmental scientist at South Florida Water Management District and currently serves as a volunteer. He has more than 40 years of experience in planning, design, monitoring and evaluation of water management, environmental restoration and resource protection plans and projects in South Florida aquatic ecosystems.

Contact Information: Joel VanArman, 4077 Luzon Ave., Lake Worth FL 33461, Phone: 561-964-7469, Email: jovanarm@sfwmd.gov

ORGANIC PHOSPHORUS FORMS IN THE EVERGLADES WETLAND SOILS

***Lilit Vardanyan*[1]**, *Taylor Smith*[1], *Sue Newman*[2], *and K. R. Reddy*[1]
[1]Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

Solution ^{31}P Nuclear Magnetic Resonance (NMR) spectroscopy is now used for characterizing organic forms of phosphorus (P) in soils and sediments. Limited information is available on adaptation of this method for high organic matter and low P soils such as those encountered in the Everglades. In this study we have examined various optimization methods including P extraction methods and NMR acquisition parameters to improve the identification of organic P forms in soils. Based on previously published reports, we have made several refinements in standardizing this technique for use in wetland systems. We used soil samples from three sites: Ordway Preserve site, Gainesville, FL; Everglades Water Conservation Area-2A (interior unimpacted site); and the Everglades Stormwater Treatment Area -2.

Our results showed that pretreatments of soil sample such as air drying and freeze drying had minimal effect on delineation of organic P functional groups as determined by NMR analysis. Air drying of samples at 35ºC appeared to be a suitable option for reducing sample heterogeneity. Although, oven drying of soils at 70ºC improved both organic P extraction efficiency (NaOH- EDTA) and NMR spectra, it was likely that relative proportion of P forms might have been altered. Fresh samples exhibited low efficiency in P extraction and resulted in unreliable NMR spectra. Extractions of low P soils with 0.5 M NaOH-EDTA gives higher extraction rates and improves the readability of the spectra compared that to extractions with 0.25 M NaOH-EDTA. Soil to solution (NaOH-EDTA) ratios of 1:20 or 1:40 were found to be suitable for obtaining reliable spectra. For low P soils, concentration of solutions before loading into NMR tubes improved overall NMR spectra. Organic P functional groups such as phosphonates, phosphomonoesters, phosphodiesters, polyphosphates and pyrophosphates were identified and quantified during the analysis. All functional groups were present in soil samples from Ordway Preserve sites and STA-2, while only monoesters and low levels of diesters were recorded in soil samples from WCA due to low P concentration in the soil.

BIO: Dr. Lilit Vardanyan is a postdoctoral Research Associate with more than 12 years of experience in biogeochemistry of water and plants of lakes, rivers and the wetlands from different part of the world. She has worked on many different projects related to the wetland and lake restoration.

Contact Information: Lilit Vardanyan, Wetland Biogeochemistry Lab, Soil and Water Sciences Department, IFAS, University of Florida, PO Box 110290, 2181 McCarty Hall A, Gainesville, FL 32611, Phone: (352)-777-3809, Email: lilitvardanyan@ufl.edu

DEVELOPMENT, PERSISTENCE, AND IMPACTS OF A DECADE LONG MACROALGAL BLOOM IN BISCAYNE BAY

***Galia Varona*[1]**, *Christian Avila*[1], *Ligia Collado-Vides*[2], *Jamie Monty*[1]
[1]Miami-Dade County Department of Regulatory and Economic Resources Division of Environmental Resources Management (DERM), Miami, FL, USA
[2]Florida International University, Miami, FL, USA

A macroalgal bloom composed by two species of the genus *Anadyomene* (Chlorophyta) has persisted in the North-Central-Inshore (NCI) region of Biscayne Bay for ten years. The bloom developed during 2004-2005, grew to extraordinary cover and abundance during 2009-2013, and has decreased since then. The bloom is confined to an area of about 50km² in Biscayne Bay, where water quality characteristics are affected by canal and potential groundwater discharges. DERM's seagrass monitoring program, has maintained additional efforts to understand the spatio-temporal dynamics, the extent of impact and the status of this unprecedented bloom in order to understand its causes.

Prior to the development of *Anadyomene* spp. to bloom proportions (1999 – 2003), the NCI region was a seagrass community, composed primarily of *Thalassia testudinum*, followed by *Syringodium filiforme* and *Halodule wrightii.* Through this pre-bloom period, Green Algae (as a monitoring category) had a low abundance, with most sites showing a <5% cover, while *T. testudinum* presented a coverage >50% in most of the area. The inverse pattern of *Thalassia* and Green Algae coverage was detected during 2009-2013 bloom peak. Interestingly, throughout the period of the bloom (2004-present), the bloom area has not expanded beyond the NCI region.

Even though the last three years have shown a decline in the bloom in terms of area of coverage and volume, a decrease in the total seagrass coverage has continued through the present. An estimated area of 42 km² (more than 75%) of seagrass cover has been lost as result of the *Anadyomene* spp. bloom. The most recent monitoring efforts in 2016 indicate some increases in *Halodule* and *Syringodium* coverage (5%), along with an increase in the frequency of calcareous Green Algae in the area.

<u>BIO</u>: Galia Varona is the current field operations manager for the Submerged Aquatic Vegetation projects in the Restoration and Enhancement Section at DERM. She has a degree in Biology with postgraduate studies in Marine Ecology and Aquaculture and has worked as Biologist at Miami-Dade County, DERM since 2006.

<u>Contact Information</u>: Galia Varona Trujillo, Miami-Dade County Division of Environmental Resources Management. 701 NW 1st Court, 5th Floor, Miami, FL 33136 USA, Phone 305-372-6913, Email: varong@miamidade.gov

EVALUATION OF INUNDATION DEPTH AND DURATION THRESHOLD FOR CATTAIL SUSTAINABILITY – IN-SITU STUDY

Kristin Vaughan[1] *and Orlando Diaz*[2]
[1]Ecology and Environment, Inc., Wellington, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

Emergent aquatic vegetation (EAV) communities are a critical component of the Stormwater Treatment Areas (STAs), as they greatly reduce phosphorous (P) concentrations on the front end of the system. *Typha domingensis* is the most dominant vegetation present in the EAV cells of the STAs, making cattail research a critical component of the Everglades Restoration Strategies Science Plan developed by the South Florida Water Management District (SFWMD). Key Science Plan questions pertaining to cattail include 1) What measures can be taken to enhance vegetation-based treatment in the STAs and Flow Equalization Basins, and 2) How does water depth affect the sustainability of dominant vegetation? To help answer these questions, an in-situ study was conducted to investigate how cattail is affected by inundation depth and duration in the STAs. The research began in early 2015 and will continue through the wet season of 2017. This presentation summarizes the results from the 2015 wet season monitoring events.

The influence of hydrologic conditions on phytomass, shoot density, photosynthesis, and leaf elongation of *Typha sp.* in the inflow and outflow regions of STA-1West (STA-1W) Cell 2A and STA-3/4 Cell 2A was examined. Hydrologic conditions in STA-1W Cell 2A were consistent across the cell, but vegetative conditions in the inflow region were more degraded than the outflow region. Total phytomass did not significantly differ between the inflow and outflow regions, but photosynthesis, leaf elongation rate, and shoot density were all significantly higher in the outflow region. These results suggest that while the structure of the cattail did not differ across the cell, the cattail community composition was more robust in the outflow region. These results indicate that the significant decline in cattail population that occurred in the inflow region of STA-1W Cell 2A between 2014 and 2015 was likely due to the impacts of floating vegetation mats rather than direct impacts by hydrologic conditions.

Hydrologic conditions in STA-3/4 Cell 2A were consistently deeper in the inflow region than the outflow region of the cell. The cattail communities in this cell, which was rehabilitated through drawdown in 2014, showed no significant difference in total phytomass, photosynthesis, or plant density between the inflow and outflow regions, but leaf elongation was significantly higher in the inflow region based on 2015 wet season monitoring results. These data suggest that deeper water conditions may stimulate leaf growth rates. Because of the hydrologic differences between the inflow and outflow regions of this cell, and because the inflow region is almost always deeper than target stage, continued monitoring through the 2017 wet season will provide insight to how extended duration of deep water conditions affects cattail populations over time.

BIO: Kristin Vaughan is a senior scientist with 8 years of experience researching in the STAs of south Florida.

Contact Information: Kristin Vaughan, Ecology and Environment, Inc., 12300 South Shore Blvd. STE 222, Wellington, FL, USA 33414, Phone: 561-254-8929, Email: kvaughan@ene.com

EVALUATION OF MERCURY AND TOXIC METALS CONCENTRATIONS IN TISSUES OF OSPREYS ADMITTED AT SOUTH FLORIDA WILDLIFE CENTER

***Anna Vecchione*[1]**, *Renata Schneider*[2], *Antonia Gardner*[2],
[1]Sea Life Conservation and Arts, Charleston, SC, USA
[2]South Florida Wildlife Center, Fort Lauderdale, FL, USA

Osprey is a bird of prey which feeds mainly on fish with the recognized function of being a bio-monitor. Cases of admission of osprey have been recorded at the South Florida Wildlife Center (SFWC) a center involved in wildlife rescue, rehabilitation and release in the tri-county area of Palm Beach, Broward and Miami- Dade.

Tissues from debilitated and moribund ospreys admitted at SFWC were evaluated for toxic metals concentrations in kidney and liver. In one specimen mercury level in kidney tissue was 40.49 mg/kg (ppm) while in liver tissue it was 27.35 mg/kg (ppm). Lead in kidney and liver had the same value of <20 mg/kg (ppm) with kidney and liver arsenic concentrations of <0.07 mg/kg (ppm). Arsenic levels were high in a second specimen with values of 1.4 mg/kg (ppm) for kidney and liver 1.97 mg/kg (ppm). In this specimen mercury and lead in kidney and liver were <0.2mg/kg (ppm) and 2.05 mg/kg respectively. Due to the protective function of selenium against mercury toxicity, tissue samples from other specimens were evaluated for selenium also. One specimen had kidney concentration of mercury of 30.48 mg/kg and had kidney selenium concentrations of 15.35 mg/kg. The concentration of mercury in liver was 11.06 mg/kg (ppm) and selenium was 8.11 mg/kg (ppm). A specimen with kidney concentration of mercury of 29.40 mg/kg also had kidney selenium concentrations of 13.81 mg/kg. Concentration of mercury in liver was 11.48 mg/kg (ppm) and selenium was 4.78 mg/kg (ppm). In one case liver concentrations were high with 39.02 mg/kg and selenium 11.10 mg/kg (ppm). Three specimens had concentrations of mercury below 6 mg/kg for liver but one had kidney with 7.09 mg/kg. These findings underline the importance of considering metal toxicity in Ospreys with suspicious debilitation and admitted at rescue centers.

Contact Information: Anna Vecchione, Doctor in Veterinary Medicine, Sea Life Conservation and Arts, 2139 Forest Lakes Blvd, Charleston, SC 29414, Phone: 843-766-4422, Email: anna_vecchione@hotmail.com

INFLUENCE OF THE BENTHIC FORAMINIFERAL BIOCOENOSIS ON FOSSIL ASSEMBLAGES IN THE SOUTHWESTERN EVERGLADES

Zoe Verlaak, *and Laurel S. Collins*
Department of Earth and Environment, Florida International University, Miami, FL, USA

This study investigates the extent to which living foraminifera affect their fossil record in the Everglades. Benthic foraminifera are shell-producing protists that both live on and burrow into surface sediments, so when burrowers die, their shells are added to older foraminiferal assemblages. Results will guide a paleoenvironmental study to examine the effects of past saltwater intrusion on foraminiferal assemblages and to predict the future effects on coastal areas in South Florida as a consequence of sea level rise.

Studies of paleoenvironments and sea level rely on the relationship between observed intertidal benthic foraminiferal assemblages and trends in environmental parameters. Deep-dwelling individuals may affect the development of downcore foraminiferal assemblages, and can generate a residual dead assemblage different from the initial dead assemblage, which eventually may make it into the fossil record. Studies of modern distributions are commonly based on samples of the upper 1 cm of sediment, since often more than 75 % of benthic foraminifera live there. However, when large amounts of different species or proportions of species of deep-dwelling individuals occur, the modern assemblage cannot be represented by only the upper 1 cm.

Three 30-cm-long surface cores were collected using a 5-cm-in-diameter Russian corer from three sites along the Shark River, west coast of Florida: a low marsh (SRS6), middle marsh (SRS5), and high marsh (SRS4) site. The cores were sampled every 1 cm down to 10 cm, and then for deeper depths samples were taken at intervals of 2, 4, or 5 cm. Sediment samples were preserved in an 85% buffered alcohol solution. Before analysis, each sample was stained overnight with the protein-specific dye rose Bengal, then rinsed over nested screens of 2.80 mm and 63 µm, and split into randomized subsamples with a wet splitter. Stained individuals, assumed to have been alive at the time of collection, were picked and sorted onto slides for identification.

Initial results show that at the low-marsh and mid-marsh sites, the live assemblages in the surface 2 cm and subsurface sediment are dominated by *Ammonia tepida*. For both of these sites, diversity is very low throughout the sediment column. The high-marsh site has a higher diversity than the low- and mid-marsh sites; the upper 2 cm is dominated by *Helenina anderseni* and *Trochammina inflata*, the shallow subsurface by *A. tepida*, and the deeper subsurface by *H. anderseni*. Of the total of live individuals found throughout the cores at the low-, mid-, and high-marsh sites, most of them (≥ 50 %) occur in the upper 3 cm, 10 cm, and 5 cm, respectively. The maximum living depth was 29-30 cm in the mid-marsh site. Subsurface maxima of live individuals occur at 16 cm, 10 cm, and 8 cm depth for the low-, mid-, and high-marsh sites, respectively. We conclude that the live assemblage does not have a significant effect on the composition of the total (live + dead) assemblage, so paleoenvironmental studies in this region can be based on surface (0-2 cm) samples of modern assemblages.

BIO: Zoe Verlaak is a doctoral candidate in the Geosciences. She is investigating the composition of modern foraminiferal assemblages of the Everglades and applying the results to a study of the environmental effects of past changes in saltwater intrusion.

Contact Information: Zoe Verlaak, Department of Earth and Environment, Florida International University, 11200 SW 8th Street, AHC5-360, Miami, FL 33199, Email: zverl001@fiu.edu

WATER QUALITY ALONG INFLOW TO OUTFLOW GRADIENT OF THE EVERGLADES STORMWATER TREATMENT AREAS

Odi Villapando[1]*, Rupesh Bhomia*[2]*, Jill King*[1] *and Paul Julian*[2]
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]University of Florida, Gainesville, FL, USA

This field investigation is a component of a comprehensive study to evaluate the sources, forms, flux, and transformation of phosphorus (P) in the Everglades Stormwater Treatment Areas (STAs). Specifically, the investigation is being conducted along a transect in three different flow-ways with different vegetation types under stagnant, low flow, and high flow conditions. As stormwater flows within the STAs, P removal, transformation, and cycling occur. The concentration of P observed at the outflow structure is a net result of all the processes. The flow tests will provide information on nutrient dynamics in the water column which can then be correlated with the measured biogeochemical responses and other parameters.

Continuous monitoring of water quality and environmental conditions during the flow event was conducted at six water quality monitoring stations installed along a transect in the middle of the treatment flow-way. The stations were equipped with autosamplers, water quality sondes, water level loggers, and HOBO light meters. The autosamplers collected water samples every four hours, which were analyzed for TP on discrete samples and total nitrogen (TN) and total organic carbon (TOC) on daily composited samples. Weekly surface grab samples were also collected and analyzed for TP, soluble reactive P (SRP), total dissolved P (TDP), dissolved organic carbon, TN, calcium, magnesium, inorganic nitrogen species, total suspended solids, chlorophyll, and other relevant water quality parameters. Particulate P (PP) and DOP were calculated using the measured values for TP, TDP, and SRP. In-situ measurements were also conducted for pH, temperature, specific conductivity, and dissolved oxygen.

Preliminary results from flow events in STA-2 Cell 3 show clear TP concentration gradient from inflow to outflow at all phases of the flow event. At the lower reaches of the treatment flow-way, TP concentrations were highest during stagnant condition than during periods of flow. TP in the water column was dominated by PP, followed by DOP and SRP. The majority of the reduction in TP along the treatment flow-way is due to reduction in particulate P. Both DOP and SRP were reduced gradually, however SRP reduction was more consistent and greater than that for DOP. During the entire flow event, SRP was effectively reduced to non-detectable levels starting at the middle region of the flow-way. Concentrations of TP were generally higher during stagnant period than during flow period, which could have important implications for STA operations and performance particularly near the outflow region.

<u>BIO</u>: Dr. Villapando is a lead environmental scientist with several years of experience managing water quality improvement projects in support of the Lake Okeechobee and Everglades Restoration programs. He has been working on the STAs for many years, specifically the northern STAs since their inception and most recently, as a technical lead for the P flux study being conducted as part of the District's Restoration Strategies Science Plan.

<u>Contact Information</u>: Odi Villapando, South Florida Water Management District, West Palm Beach, FL 33406 Phone: 561-682-2936, Email: rvillap@sfwmd.gov

NEXT STEPS TOWARDS RECOVERY OF THE CAPE SABLE SEASIDE SPARROW

Thomas Virzi
Ecostudies Institute, East Olympia, WA, USA

The federally endangered Cape Sable seaside sparrow *(Ammodramus maritimus mirabilis)* relies on seasonally flooded marl prairies found in the southern Everglades for its entire life cycle, and management of sparrow habitat has often been controversial. The sparrow currently occurs in six distinct subpopulations of varying density, and all have been affected by water management actions to some degree. Proper water management is only one component of the steps necessary for the recovery of the sparrow and its habitat. A recent interagency memorandum of understanding outlined steps necessary to aid in the recovery of the subspecies, and several actions have already been implemented. As Everglades restoration has advanced, some positive changes have already occurred within existing Cape Sable seaside sparrow habitat. However, in some instances sparrows have not yet recolonized these areas to the point where healthy subpopulations have re-established themselves. Extensive demographic research conducted over the past two decades suggests several factors might be acting together to limit population recovery including: 1) low reproductive rates resulting in limited local recruitment, 2) limited dispersal among subpopulations, and 3) a lack of appropriate conspecific cues in low density subpopulations limiting territory establishment by dispersing individuals. Since 1998, sparrows have been color banded and despite almost 20 years of resight surveys there have been only 13 recorded between-subpopulation dispersal events. Local recruitment alone is unlikely to allow recovery of low density sparrow subpopulations, and with such low dispersal rates it may be necessary to consider other management actions such as translocation of individuals to bolster small sparrow subpopulations and aid recovery. Recent habitat modeling has identified new areas where there are existing opportunities for sparrow reintroduction; however, before any translocation experiment is attempted a detailed translocation plan should be designed and trial translocations implemented. Thus, it is imperative that such a plan be initiated as soon as possible to prepare for future opportunities to reintroduce sparrows into newly restored areas as Everglades restoration advances.

BIO: Dr. Virzi is a research ecologist with Ecostudies Institute, a non-profit institution dedicated to conserving birds and their habitats through science, restoration, and outreach. Dr. Virzi brings 10 years of experience studying the Cape Sable seaside sparrow, helping to inform management actions for recovery of the species.

Contact Information: Thomas Virzi, PO Box 735, East Olympia, WA, USA, 98540, Phone: 732-859-7470, Email: tvirzi@ecoinst.org

DIGITAL VISUALIZATION AS A TOOL TO BRIDGE SCIENCE AND POLICY: EXAMINING THE LONG-TERM EFFECTS OF PHOSPHORUS ON THE EVERGLADES RIDGE SLOUGH LANDSCAPE

***John C. Volin*[1]**, *Sue Newman*[2], *Dan Pejril*[1], *and Lindsay Dreiss*[3]
[1]University of Connecticut, Storrs, CT, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA
[3]Middlebury College, Middlebury, VT, USA

Everglades restoration remains one of the largest ecosystem-level restoration projects ever attempted. The underlying message to "Get the Water Right" was that both water quality and hydrology, including timing, flow and quantity, were being optimized to the extent possible to assure the best outcome for a naturally functioning Everglades ecosystem. Today, the 15th year since the restoration was approved, there has been criticism by some for its slow pace, while others applaud the successes. The former would like to increase the pace of restoration, which has inevitably resulted in debate among scientists regarding water quality and quantity tradeoffs. This technical discussion among scientists makes it difficult for decision makers, who ultimately are responsible for moving the restoration forward. The central Everglades is dominated by the ridge slough ecosystem and is the focal area of much of the debate. Here we present a digital animation based on peer-reviewed data that demonstrates visually a cross-section of a representative ridge slough system through various stages of TP enrichment. The objective of the animation, presented previously in a beta version, is to provide context of the complex interactions that occur in the ridge slough with increasing TP concentrations, with the primary intent to facilitate a more holistic understanding of the system as one tool that could be used by decision-makers, but also for ongoing communication among the scientific community.

BIO: John Volin's area of expertise is in plant physiological ecology, but he has always been most excited when addressing complex problems in an interdisciplinary manner to ultimately seek and advance solutions.

Contact Information: John C. Volin, Department of Natural Resources and the Environment, University of Connecticut, 1376 Storrs Rd., Unit 4087, Storrs, CT 06269-4087 USA, Phone: 860-486-0137, Fax: 860-486-5408, Email: john.volin@uconn.edu

DETECTING SIGNS OF IMPENDING LARGE-SCALE ECOLOGICAL REGIME SHIFTS IN SOUTH FLORIDA ESTUARIES THROUGH THE LENS OF PALEOECOLOGY

***Anna Wachnicka*[1] *and G. Lynn Wingard*[2]

[1]Florida International University, Miami, FL, USA
[2]U.S. Geological Survey, Reston, VA, USA

Resilient ecosystems can absorb large disturbances before switching to a different stable state and they are the result of both intrinsic and extrinsic characteristics of that ecosystem. It is very hard to recognize whether ecosystems are resilient or not on short time scales, because disturbances are difficult to quantify and ecosystem regime shifts are very rare. However, over long time scales (decadal to centennial), resilient systems will display stability in community composition as ecosystems rebound toward equilibria following disturbance or resist disturbances entirely. Given the predicted severity of impending climate change, it is extremely important to eliminate or reduce local drivers of ecological change, which will increase the ability of an ecosystem to resist, and ultimately recover from, future climate disturbances.

While disturbance caused by natural factors is a normal part of the ecosystem, human actions can create unique types of disturbance (e.g., pollution) and magnify natural disturbance, which adds to the level of disturbance an ecosystem must deal with. Healthy ecosystems can often cope with this extra disturbance, but too much of it lowers its resilience. Ecosystems with low ecological resilience can easily be tipped into an alternative state by stochastic events. Analysis of long-term fossil records preserved in thirteen sediment cores collected from Florida Bay, Biscayne Bay and the southwest coast of the Everglades were used to investigate the ecosystems' resilience. Diatom assemblages from several nearshore cores showed significant shifts between the 1950s and the 1960s, and some also in the 1980s. These periods often coincided with changes in precipitation, and periods of construction of a dense network of canals and levees in this region. In central-north Biscayne Bay, No Name Bank, which has been disturbed by dredging, water management practices in adjacent coastal wetlands and urban pollution, experienced large shifts in diatom assemblage structure in the mid-1950s and mid-1980s. Variance in percent assemblage similarity at this location has also been steadily increasing since the early 1950s. Increase in variance often signals an impending regime shift, which might occur at this location on a much bigger scale in the future, if ecological resilience continues to decline as a result of a combined natural and anthropogenic disturbance. Resilience loss can feed back on itself, because disturbance has a greater effect on ecosystems that have already lost resilience. Similar patterns have been observed in many other cores from Florida Bay and the southwest Florida coastal area, possibly signaling declining ecosystem resilience in this region and a potential large-scale ecosystem regime shift in the future.

BIO: Dr. Wachnicka is a research geoscientist with over 15 years of experience conducting paleoecological and ecological studies in coastal and marine ecosystems of south Florida in support of the Everglades restoration.

Contact Information: Anna Wachnicka, Southeast Environmental Research Center, Florida International University, OE 235, Miami, FL 33196; Phone: 305-348-1876; Email: wachnick@fiu.edu

USING FLUCCS CODES AND GIS SPATIAL ANALYST TOOLS FOR WETLAND RESTORATION

Paul Walansky[1]*, Kwaku Oben*[1]*, Ahmad Salah*[2]
[1]Stanley Consultants, West Palm Beach USA
[2]Stanley Consultants, Salt Lake City USA

Determining the ideal dry and wet season condition for an ecologically diverse wetland is not an easy task. Each ecological plant community has a different dry and wet season water depth and hydroperiod. This challenge has been solved by utilizing a combination of 2D GIS tools and Florida Land Use Cover and Classification System (FLUCCS) Codes. The FLUCCS codes provide the ideal water depth range of each vegetative community and the 2D GIS tools provide spatial allocation of the areas that will thrive at a given water stage. Once an optimum water depth is identified, hydraulic structures are designed to hold water at that stage for a period of time similar to the average hydroperiod of the dominant vegetative communities. The closer the match between number of inundation days and target hydroperiod, the higher the likelihood of the wetland communities succeeding. This general approach can be used for any wetland design, restoration or management.

Stanley Consultants is under contract with the USACE to perform wetland restoration analysis and design of improvements for three restoration sites in their Wetland Reserve Program. (WRP). Shallow borings were also performed to examine soil conditions. In addition, the current land use and vegetative communities map based on the FLUCCS was studied at each site. With this method of analysis the success rate of these wetland restoration projects can be greatly increased.

BIO: Paul Walansky has professional experience since 1999 in the design and construction management of water resources and coastal projects. His expertise includes condition assessment of marinas and water control structures, cost estimating, flood studies, pump station design, bridge scour analysis, economic analysis, port feasibility studies, pier and retaining wall design.

Contact Information: Paul Walansky, P.E., 1641 Worthington Road, Suite 400, West Palm Beach, FL 33409, Phone: 561-584-8724, Fax: 561-689-3003, E-mail: walanskypaul@stanleygroup.com

CITIZEN SCIENCE AND IVEGOT1

Charles T. Bargeronand and ***Rebekah D. Wallace***
University of Georgia Center for Invasive Species and Ecosystem Health, Tifton, GA, USA

The University of Georgia Center for Invasive Species and Ecosystem Health (Bugwood) has worked with programs all over the U.S. and Canada to develop websites and smartphone applications, based around the EDDMapS website and database, which can meet their needs of a centralized database as well as data sharing, querying, and visualization for their mapping and management efforts. The collection of new data from professionals as well as citizen scientists using these tools is vital to provide a more complete picture of where and when species are being found, in as close to real-time as possible. Working with various agencies and programs within Florida specifically has allowed for not only excellent promotion of and use of the IveGot1 app, but also has led to a robust verification network to allow reports to be accurately and quickly verified by local experts. Data submitted through individual reports, as well as through file submissions of existing data, have now grown the database to over 3 million reports of invasive species over the U.S. and Canada and data and maps have been downloaded for a variety of uses, including in creating invasive species lists, research and modeling, outreach materials, and more.

BIO: Rebekah Wallace has a Master of Crop and Soil Sciences from the University of Georgia and is the Data Coordinator for the EDDMapS program at the Center for Invasive Species and Ecosystem Health (Bugwood).

Contact Information: Rebekah Wallace Center for Invasive Species & Ecosystem Health, University of Georgia, 2360 Rainwater Road, Tifton, GA 31793, Phone (229) 386-3298, Email: bekahwal@uga.edu

HYDROLOGIC DRIVERS OF ECOLOGICAL PROCESSES IN THE CENTRAL EVERGLADES

***Yongshan Wan*[1]**, *Donatto Surratt*[2], *Rebekah Gibble*[1]

[1]U.S. Fish & Wildlife Service, Loxahatchee National Wildlife Refuge, Boynton Beach, FL, USA
[2]National Parks Service, Everglades National Park, Homestead, FL, USA

Wetland hydrology is perhaps the most important factor determining the ecology and habitat suitability in the northern Everglades. We proposed a unified hydrological performance metric system for evaluation of hydrological conditions in the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Requirements of the performance metrics were established through identification of the magnitude, duration, and frequency of critical water levels or water depths to support a range of ecological needs and management of exotics. These metrics were used to evaluate the hydrological condition of the Refuge over the past two decades, covering a wide range of hydrological variabilities. Our analyses emphasized the importance of both climatic drivers (rainfall and evapotranspiration) and water management (inflow and outflow) in the control of water level changes in the Refuge. This study provides a framework for evaluating hydrologic conditions and habitat management throughout the managed landscape in the Everglades.

Contact Information: Yongshan Wan, Ecologist, EPA, 10216 Lee Rd, Boynton Beach, FL 33473, USA, Email: wan.yongshan@epa.gov

TREE ISLAND RESTORATION IN THE FLORIDA EVERGLADES: REVERSING THE EXOTIC PLANT INVASION

Marsha R. Ward[1], *Michael Anderson*[2], *Melissa Juntunen*[3] *and Lindsay Nester*[4]
[1]Florida Fish and Wildlife Conservation Commission, Sunrise, FL, USA
[2]Florida Fish and Wildlife Conservation Commission, West Palm Beach, FL, USA
[3]U.S. Fish and Wildlife Service, Loxahatchee, FL USA
[4]U.S. Fish and Wildlife Service, Vero Beach, FL USA

Tree island habitat represents a relatively small portion of the spatial area within the Florida Everglades, but this habitat type is essential to the functional integrity of the entire Everglades ecosystem. Anthropogenic manipulation within the Everglades, which began over 100 years ago, contributed to the degradation of many tree islands. Much talk, research, and funding has gone into Everglades' water flow restoration; however, comparatively little attention has been paid to tree island restoration. This restoration project attempts to explore invasive control, planting techniques, and species survival rates for tree island restoration. The Florida Fish and Wildlife Conservation Commission has been working to restore tree islands, including removing invasive exotic vegetation (i.e. primarily Brazilian pepper *Schinus terebinthifolius*), planting native tree and shrub species on tree islands, and collecting associated survivorship data, since the early 1990s on the Everglades Complex of Wildlife Management Areas. After initial clearing, restoration tree islands are maintained annually for invasive exotic vegetation, which is critical to maintaining low levels of infestation. Currently, restoration tree islands present extremely low levels of exotic vegetation (<5%). Planting techniques are based on island characteristics and survivorship. The marsh surrounding restoration tree islands is routinely prescribed burned as part of the process. Annual surveys determine plant survivorship over time. Overall, success rates for planted species are high (approximately 70%). Species such as bald cypress *Taxodium distichum*, pop ash *Fraxinus caroliniana*, buttonbush *Cephalanthus occidentalis*, and red maple *Acer rubrum* all have large sample sizes and probability of success greater than 75%. Cocoplum *Chrysobalanus icaco*, leatherfern *Acrostichum L.*, and firebush *Croton lucidus* had some of the lowest probability of survival, but still greater than 50%. Although species survival rates vary by species and by individual islands, the importance of promotion of plant diversity and subsequent benefits for wildlife cannot be underestimated. Monitoring tree islands helps guide management and restoration efforts throughout the Everglades.

BIO: Marsha Ward is a wildlife biologist with over 10 years of experience working in the Florida Everglades. She has extensive experience with wetland restoration and wildlife and habitat management.

Contact Information: Marsha Ward, Florida Fish and Wildlife Conservation Commission, 10088 NW 53rd Street, Sunrise, FL, USA 33442, Phone: 954-453-1781, Email: marsha.ward@myfwc.com

ESTIMATING MANGROVE CANOPY HEIGHT AND ABOVE-GROUND BIOMASS IN THE EVERGLADES NATIONAL PARK WITH AIRBORNE LIDAR AND TANDEM-X DATA

*Emanuelle A. Feliciano[1,2], **Shimon Wdowinski[3]**, Matthew D. Potts[4], Seung-Kuk Lee[1,2] and Temilola E. Fatoyinbo[1]*
[1]NASA Goddard Space Flight Center, USA
[2]Universities Space Research Association, USA
[3]Florida International University, Miami, FL, USA
[4]University of California, Berkeley, CA, USA

The coastal mangroves forests of Everglades National Park (ENP) are well protected from development. However, sea level rise and climate change are processes that could potentially affect the health and well-being of these ecosystems. The protected coastal mangrove forest of the ENP is an ideal location for studying mangrove growth and recovery, as harmful human activities are minimal. The monitoring of forest structural parameters such as canopy height and above-ground biomass (AGB) could provide a good measure of temporal changes in these intertidal ecosystems. It is possible to study the vertical structure of forests (canopy height) using remote sensing sensors from air- or space-borne LiDAR/Laser Scanning or space-borne Synthetic Aperture Radar (SAR) systems such as Shuttle Radar Topography Mission (SRTM) and TanDEM-X (TDX). Forest canopy height has a well-understood and directly proportional correlation with AGB.

In this study, we estimated mangrove canopy height in the ENP using an Airborne LiDAR (ALS) dataset and TDX datasets acquired during the years 2011-2013. The ALS dataset was acquired along a 16.5 x 1.5 km swath of mangrove forest with variable canopy height in Shark River Slough. Analysis of both height datasets showed that mangrove canopy height can reach up to ~25 m and AGB can reach up to ~250 $Mg.ha^{-1}$ along the western coastal edge of ENP. The comparison of ALS and TDX canopy height observations yielded an $R^2 = 0.85$ and RMSE = 1.96 m. Results show that mangroves stands ranging from 9 m to 12 m in stature dominate the forest canopy and that AGB ranges from 90 $Mg.ha^{-1}$ to 120 $Mg.ha^{-1}$. Compared to a previous study based on data acquired during the years 2000-2004 (Simard et al., 2006), our analysis shows an increase in mangrove stature and AGB, suggesting that ENP mangrove forests are in a steady growth situation. Our results suggest that ENP mangrove forests have managed to recover from natural disturbances such as hurricane Wilma in 2005.

BIO: Dr. Shimon Wdowinski is an Associate Professor for Geophysics at the Department of Earth and Environment, Florida International University. He has used space geodetic and remote sensing technologies for studying wetland hydrology and vegetation structure from space.

Contact Information: Dr. Shimon Wdowinski, Department of Earth and Environment, Florida International University, 11200 SW 8th Street, AHC5-388, Miami, FL 33199, Phone: 305-348-6826, Email: shimon.wdowinski@fiu.edu

SPACE-BASED MONITORING OF WATER LEVEL CHANGES IN THE ENTIRE EVERGLADES USING SENTINEL-1 INSAR OBSERVATIONS

Shimon Wdowinski[1] *and Sang-Hoon Hong*[2]
[1]Florida International University, Miami, FL, USA
[2]Korea Polar Research Institute, South Korea

A key element in the Everglades conservation, management, and restoration involves monitoring its hydrologic system, as the entire ecosystem depends on its water supply. Hydrologic monitoring of the Everglades is mainly conducted by stage (water level) stations, which provide good temporal resolution, but suffer from poor spatial resolution, as stage stations are typically distributed several, or even tens of kilometers, from one another. Furthermore, due to logistical constraints many of the stage stations are located near hydrological structures and often do not represent water level conditions in interior sections.

The space-based Interferometric Synthetic Aperture Radar (InSAR) technology provides the needed high spatial resolution hydrological observations. The method compares pixel-by-pixel radar phase observations of the same area acquired at different times from roughly the same location in space to produce high spatial-resolution (1-50 m pixel resolution) surface change maps. Such maps, termed interferograms, are widely used in studies of earthquake induced crustal deformation, magmatic activity, water-table fluctuations, and glacier movements. Previous InSAR studies of the Everglades relied on data with partial spatial coverage (15-100 km wide swath) and low temporal resolution (11-46 days repeat satellite orbits). The new Sentinel-1 satellite constellation, operated by the European Space Agency, provides wide coverage observations (250 km wide swath) with significantly higher temporal resolution of 6 day repeat orbit. Using the wide coverage Sentinel-1 observations, we calculated interferograms of the entire Everglades wetlands with six-day data acquisition intervals. The interferogram reveal many interesting hydrological features, including (1) flow discontinuities due to levies and roads, (2) patterns of tidal flow in the coastal Everglades, (3) water level changes due to hydrological structure operations, and (4) temporal changes in the fresh water flow characteristics. The new Sentinel-1 observations have the potential for repeated high spatial resolution monitoring of surface flow changes in the entire Everglades wetlands.

BIO: Dr. Shimon Wdowinski is an Associate Professor for Geophysics at the Department of Earth and Environment, Florida International University. He has used space geodetic and remote sensing technologies for studying wetland hydrology and vegetation structure from space.

Contact Information: Dr. Shimon Wdowinski, Department of Earth and Environment, Florida International University, 11200 SW 8th Street, AHC5-388, Miami, FL 33199, Phone: 305-348-6826, Email: shimon.wdowinski@fiu.edu

HALOPHYTES CAN SALINIZE SOIL WHEN COMPETING WITH GLYCOPHYTES, INTENSIFYING EFFECTS OF SEA LEVEL RISE IN COASTAL COMMUNITIES

***Kristie S. Wendelberger*[1]** *and Jennifer Richards*[2]

[1]The Everglades Foundation, Miami, FL, USA

[2]Florida International University, Miami, FL, USA

Sea level rise (SLR) and human disturbances are working together to change coastal communities around the world. Along Florida's coast, SLR and large-scale ecosystem drying are increasing groundwater salinity, driving shifts in coastal plant community composition. Halophytic (salt-tolerant) species have been documented moving into glycophytic (salt- intolerant) communities. We hypothesized that halophytes increase soil salinity, as compared to glycophytes, through continued transpiration during dry, highly saline periods, drawing saline groundwater up through the soil column via capillary rise. We tested our hypothesis with a replacement series greenhouse experiment with halophyte/glycophyte ratios of 0:4, 1:3, 2:2, 3:1, 4:0 and halophyte/glycophyte species combinations of *Batis maritima* versus *Heliotropium angiospermum*; *B. maritima* versus *Alternanthera flavescens*; *Sarcocornia perennis* versus *H. angiospermum*; and *S. perennis* versus *A. flavescens*. We subjected the replicates to 0, 26, and 38 ‰ salinity for one, one, and three months, respectively, taking soil salinity and stomatal conductance measurements at the end of each treatment period. Our results show halophytes increased soil salinity with increasing halophyte density but not directly from higher transpiration rates; per unit area stomatal conductance was the same for both halophytes and glycophytes after salinity treatments began. Instead, either osmotic or ionic stress caused decreases in glycophyte biomass, resulting in less plant transpiration overall. Once halophytic individuals establish, they increase soil salinity throughout the soil column, making conditions more conducive to further halophyte establishment. This study suggests that coastal plant community turnover may occur faster than would be predicted from SLR and anthropogenic disturbance alone.

<u>BIO</u>: Dr. Wendelberger is the Outdoor Education and Outreach Coordinator at The Everglades Foundation. She has over 13 years of experience as a plant ecologist in the Everglades ecosystem. Her focus is rare plant and ecosystem conservation. She has participated in numerous experiments and projects focused on south Florida conservation.

<u>Contact Information</u>: Kristie Wendelberger, The Everglades Foundation, 18001 Old Cutler Road, suite 625, Miami, FL, USA 33157, Phone: 305-281-3061, Email: kwendelberger@evergladesfoundation.org

BIOCONTROL OF WEEDS IN THE GREATER EVERGLADES ECOSYSTEM: PROCESS, CHALLENGES AND PATHS FORWARD

Greg Wheeler
USDA/ARS, Fort Lauderdale, FL, USA

Brazilian peppertree, Schinus terebinthifolia *(Anacardiaceae)*, is a South American plant that has become invasive in many countries around the world. It was introduced into the USA about 100 years ago as an ornamental. Escaping cultivation, it now occurs in three southeastern states of the USA, California, and Hawai'i. This species constitutes one of the most invasive weeds threatening agriculture and the natural areas of the region. Efforts to manage S. terebinthifolia populations with biological controls began in Hawai'i in the 1950s and resulted in the release of three insect species. However, the agents have had minimal impact and the weed continues to be a difficult problem. An international team of collaborators has more recently discovered and tested numerous new species of potential biological control agents. These species attack different plant tissues and include defoliators, sap suckers, stem borers, and leaf and stem gall formers. Despite difficulty finding an agent sufficiently specific for field release in Florida, we have narrowed the field to two promising species, a thrips, Pseudophilothrips ichini and a foliage gall-former, Calophya latiforceps. Results of no-choice and choice trials conducted overseas and in quarantine indicate both species will safely contribute to the control of this invasive weed. The immature and adult feeding by both herbivore species will stunt the growth, distort leaves, and should reduce reproductive output of Brazilian peppertrees.

Contact Information: Greg Wheeler, USDA/ARS, Fort Lauderdale, FL, USA, Phone: 954-475-6546, Email: greg.wheeler@ars.usda.gov

REFINING FLOW RESTORATION TO WORK WITH THE LANDSCAPE

Walter M. Wilcox*, Fahmida Khatun, Wasantha Lal, M. Clay Brown and Colin Saunders*
South Florida Water Management District, FL, USA

America's Everglades is a highly unique ecosystem which is largely supported by an equally unique ridge and slough landscape comprised of densely vegetated marshes and tree islands comingled with connected open water sloughs. After significant historical alteration, the Comprehensive Everglades Restoration Plan (CERP) was authorized in the Water Resources Development Act of 2000 to provide a means to restore this significant and valuable resource. Ongoing restoration efforts have successfully planned and constructed many elements of CERP, culminating in the Central Everglades Planning Project (CEPP) which takes a significant step in restoring long-term hydroperiods to the Everglades landscape, thereby maintaining the presence of water in this wetland environment.

Future CERP project efforts will need to move beyond the restoration goals obtained to date, which have largely focused on avoiding dry condition impacts, and begin to focus on more challenging aspects of landscape dynamics, including desired flow velocities and floc transport mechanisms during wetter events. In this context, restoration science and modeling tools must evolve to help inform desired objectives and to provide a means to evaluate proposed project actions. To this end, recent field studies including efforts by the CERP Decomp Physical Model project and the South Florida Water Management District's Restoration Strategies Science Plan are looking to help reduce uncertainty moving forward and are providing valuable new information related to water movement and vegetation resistance that are directly applicable to the unique challenges of the Everglades landscape.

Anticipation of the CERP planning needs in combination with the availability of new research will fundamentally alter and improve the conceptualization of overland flow dynamics in the regional hydrologic models that are utilized in CERP. Models such as the Regional Simulation Model (RSM) and the Natural System Regional Simulation Model (NSRSM) are now being updated to provide an improved representation of the Everglades microtopography and overland flow dynamics moving beyond the traditional Manning's flow assumptions that have historically been utilized.

Through a combination of 1) understanding what restoration efforts to date (including CEPP) have accomplished, 2) examining newly available research and field studies and 3) pursuing updates to the modeling tools that are extensively used in CERP planning, a path forward for defining Everglades restoration flow objectives can be pursued. This will provide a meaningful framework and set of evaluation tools for future project planning efforts that will ensure that fundamental landscape processes are reestablished and that America's Everglades will be restored and sustained into the future.

BIO: Walter Wilcox is Director of the Modeling Section of the Hydrology & Hydraulics Bureau at the South Florida Water Management District. Walter has over 15 years of experience in supporting Everglades restoration planning efforts and has extensive knowledge of the modeling and evaluation tools utilized in South Florida's unique environment.

Contact Information: Walter M. Wilcox, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL, USA 33406, Phone: 561-682-2527, Email: wwilcox@sfwmd.gov

LONG-TERM PATTERNS OF COASTAL RESPONSE TO CHANGING LAND USE AND CLIMATE: EXAMPLES FROM THE ATLANTIC AND GULF COASTAL PLAINS

***Debra Willard**, Christopher Bernhardt, and Miriam Jones*
U.S. Geological Survey, Reston, VA, USA

At many coastal sites in the Atlantic and Gulf Coastal Plains, scientists have observed a progressive degradation of tidally influenced, freshwater forested wetlands and their replacement by marshes, with a net effect of landward transgression of tidal marshes. This shift has been attributed to a range of external forcing factors, including sea level rise, climate-driven changes in precipitation and water availability, and anthropogenic changes related to water management, agriculture, and urbanization. To better understand the resilience of coastal habitats under different environmental changes, we reconstructed vegetation trends using pollen and plant macrofossils from radiocarbon-dated sediment cores collected in coastal marshes and tidal freshwater forested wetlands in Alabama, Florida, Georgia, and South Carolina. These records illustrate that both natural climate variability and human alteration of the landscape have significant impacts on the distribution of coastal vegetation.

Changing sea level and fluctuations in fresh-water flow affected all these sites even before Colonial-era land clearance began. A 4,500 year-long sedimentary record from Fowl River marsh near Mobile, Alabama indicates that a *Nyssa*-dominated swamp occupied the site until ~2,500 cal yr BP, when a sharp transition to a marsh occurred. At sites along Florida Bay and the Gulf of Mexico, shifts from freshwater marshes to mangrove swamps occurred as early as 3,000 years ago, as rising sea level transgressed the coast. Coastal wetlands along the Savannah and Waccamaw Rivers in Georgia and South Carolina exhibit hydrologic fluctuations during the last 5,000 years, with the greatest changes occurring at sites nearest the coast, where forested wetlands began shifting to marshes during the Medieval Climate Anomaly ~1,500 cal years BP.

Human alteration of the landscape also had significant impacts on coastal vegetation. In Alabama, the increase of Ambrosia pollen, the marker for Colonial ecological disturbance, indicates that land use changes resulted in a brief increase, followed by a sharp decrease in carbon accumulation rates. In south Florida, diversion of water from the greater Everglades wetland to the coasts during the 20th century altered hydroperiods and wetland vegetation in locally variable ways. Records from the Savannah River show evidence of rice agriculture in the 18-20th century. Colonial land clearance also caused increases in terrestrial sediment influx resulting in elevated carbon accumulation rates, which subsequently declined within the last 100 years.

Although significant fluctuations in water availability occurred at all sites during the last few thousand years, the vegetation in tidally influenced, freshwater forested wetlands changed little until Colonial times, when forests were cleared for agriculture and other needs. These sites illustrate the combined effects of land cover change, climate variability, and sea level rise on coastal wetlands and document how coastal ecosystems respond to a different environmental changes.

BIO: Dr. Willard is the coordinator for the USGS Climate Research & Development Program with more than 20 years of research in paleoecological and paleoclimate research in the Everglades and other wetlands in the southeastern United States.

Contact Information: Debra A. Willard, U.S. Geological Survey, 12201 Sunrise Valley Drive, MS 926A, Reston, VA 20192, Phone 703-646-5320, Email: dwillard@usgs.gov

FINDING NIMO: EDNA DETECTION OF NILE MONITORS (*VARANUS NILOTICUS)*

***Kelly E. Williams**, Antoinette J. Piaggio, Doreen L. Griffin*
National Wildlife Research Center, Fort Collins, CO, USA

Few habitats remain that have not been affected by invasive species introduced in some way by humans. Effective detection and management strategies are necessary to limit successful invasions and preserve native wildlife and ecosystems. Environmental DNA (eDNA) is DNA that is released from an organism into the environment and can be detected in cellular or extracellular forms. The application of environmental DNA detection techniques to an invasive species can provide a method of surveillance that outperforms traditional observational methods. The Nile monitor (*Varanus niloticus*) is a destructive, invasive species in Florida. Florida is especially susceptible to exotic invasions due to the pet trade and (un)intentional releases of foreign species, both terrestrial and marine. The Nile monitor poses a unique threat in that they are opportunistic in both habitat and diet, and are predators of protected species. Molecular detection of Nile monitor DNA in environmental samples could provide an effective method for detecting this elusive species on the invasion front.

BIO: Kelly Williams is a Biological Science Technician in the Wildlife Genetics lab at the National Wildlife Research Center. She recently graduated with her Master's degree in Ecology with a concentration in Fish, Wildlife, and Conservation Biology from Colorado State University. Her graduate research involved developing methods of detection for an invasive, terrestrial species using environmental DNA. Since graduation, she continues working on eDNA projects through the genetics lab.

Contact Information: Kelly Williams, Wildlife Genetics Lab, National Wildlife Research Center, Fort Collins, CO, USA, 80521,
Phone: 970-266-6270, Email: Kelly.E.Williams@aphis.usda.gov

BIOGEOCHEMICAL AND PHYSIOLOGICAL EFFECTS OF SIMULATED SEA LEVEL RISE IN THE COASTAL EVERGLADES

***Benjamin J. Wilson*[1]**, *Shelby Servais*[1], *Viviana Mazzei*[1], *Tiffany Troxler*[1], *Fred Sklar*[2], *John Kominoski*[1], *Evelyn Gaiser*[1], *Steve Davis*[3], *and David Rudnick*[4]

[1]Florida International University, Miami, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL USA
[3]Everglades Foundation, Palmetto Bay, FL, USA
[4]Everglades National Park, Homestead, FL, USA

Coastal wetlands, which have immense potential to store carbon (C) in vegetation and sediments, are a vital part of the global C cycle. How C storage in coastal wetlands will be affected by accelerated sea level rise as a result of climate change, however, is uncertain. It is hypothesized that shifts in stressors (i.e. salinity) and subsidies (i.e. nutrients) can shift the soil carbon balance from a net C sink to a C source, stimulating peat collapse, which will, in turn, accelerate the effects of sea level rise. The objective of this study is to investigate how simulated saltwater intrusion into fresh and brackish water wetlands will change net ecosystem productivity and affect the soil C balance. Using coupled field and mesocosm experiments, we are examining how plant gross primary production, plant respiration, ecosystem respiration, microbial C processing, and net ecosystem exchange in fresh and brackish wetlands will change when exposed to saltwater and an increase in P loading. Preliminary results show that control plots took up more C than saltwater treated plots (-1019 vs -756 g m^{-2} y^{-1}, respectively), suggesting that increased saltwater exposure in a freshwater marsh dampens the capacity for C uptake. At a brackish water marsh, +saltwater plots had enhanced C release to the atmosphere compared to the controls (+1078 vs +298 g m^{-2} y^{-1}, respectively) when water dried down below the soil surface. Despite continually elevated salinity in porewater in the treated plots at the brackish site, gross ecosystem exchange was not significantly depressed compared to the controls over the entire study period, suggesting some mechanism may be helping to alleviate osmotic stress. NH_4^+ in porewater is elevated in the salt-treated plots at the freshwater site, suggesting desorption and cation replacement. However, depleted NH_4^+ and increased plant nitrogen content in salt-treated porewater at the brackish site suggest saltwater causes NH_4^+ to be made bioavailable for plants to use, possibly as a subsidy to offset the osmotic stress caused by increased salinity. Results from this study show that simulated saltwater intrusion has strong seasonal effects on C and nutrient cycling. Given uncertain changes in climate and potentially more frequent extreme events (i.e. drought) in the future, pinpointing seasonal effects of saltwater intrusion is crucial.

BIO: Benjamin Wilson is currently a gradient student at FIU finishing his Ph.D. investigating ecosystem responses to saltwater intrusion and sea level rise in the southern coastal Everglades.

Contact Information: Benjamin Wilson, Florida International University, 11200 SW 8th St. OE-148, Miami, FL, USA 33199, Phone: 205-913-8397, Email: bwils034@fiu.edu

CENTENNIAL TO MILLENNIAL SCALE PERSPECTIVE ON THE ROLE OF SALINITY IN ECOLOGICAL REGIME SHIFTS IN SOUTH FLORIDA'S ESTUARINE ECOSYSTEMS

G. Lynn Wingard[1] *and Anna Wachnicka*[2]
[1]U.S. Geological Survey, Reston, VA, USA
[2]Florida International University, Miami, FL, USA

Paleoecologic analyses of mollusks, diatoms and other organisms preserved in sediment cores collected in south Florida estuarine ecosystems illustrate changing salinity patterns over the last few centuries to millennia. Salinity is a critical factor in controlling the distribution of organisms within estuarine ecosystems, and salinity in turn is controlled by a number of internal and external drivers including sea level rise, climate, and anthropogenic alteration of freshwater availability. Significant changes in salinity patterns can lead to ecological regime shifts. Examination of the long term patterns of change, and the responses of organisms to change, can provide management agencies responsible for restoration with insight into the effects of future sea level, climate, hydrology and land use on ecological communities. Understanding the responses of the ecosystem on long-term time scales allows resource managers to explore a suite of appropriate actions for mitigation and/or adaption.

Cores examined throughout south Florida's estuaries show a general trend toward increasing salinity over the last 100 to 3000 or more years, consistent with rising sea level. Detailed analyses of the fluctuations within this general trend, however, indicate the importance of regional precipitation patterns, which are driven by extra-regional climate drivers, on salinity and organisms. For example, positive phases of the Atlantic Multidecadal Oscillation (AMO) bring warmer sea surface temperatures and more precipitation to south Florida and analyses of invertebrate fauna from cores show these positive phases correspond to periods of reduced salinity in central Biscayne Bay. Periods of prolonged drought and subsequent increases in salinity caused by cold phases of El Niño Southern Oscillation (ENSO), AMO, and other extra-regional climate patterns correspond to the largest shifts in the structure of diatom assemblages seen in cores from Florida Bay and Biscayne Bay. Additionally, many of the cores examined contain records of significant climate anomalies over the last 1500 years – the Medieval Climate Anomaly (MCA: ~650-1050 CE) and the Little Ice Age (LIA: ~1550-1750 CE). However, when the shifts in assemblage structure that occurred during past climate anomalies are compared to recent shifts, the 20th century restructuring of assemblages in Biscayne Bay exceed the degree or restructuring seen during these past climate extremes. These data provide insight into the significant impacts of 20th century hydrologic alterations on the salinity and organisms of south Florida and provide guidance for potential management actions.

BIO: Dr. Wingard is a research geologist with over 20 years of experience leading projects that apply paleoecologic analyses to understand the past coastal and marine ecosystems of south Florida in support of Everglades restoration. As part of this effort she has served on numerous science advisory teams.

Contact Information: G. Lynn Wingard, Eastern Geology and Paleoclimate Science Center, USGS, 12201 Sunrise Valley Dr., MS 926A, Reston, VA, USA 20192; Phone: 703-648-5352; Email: lwingard@usgs.gov

INSIGHTS INTO THE INTRODUCTION HISTORIES OF THE NILE MONITOR (*VARANUS NILOTICUS*) AND ARGENTINE BLACK-AND-WHITE TEGU (*SALVATOR MERIANAE*) IN FLORIDA VIA NEXT GENERATION SEQUENCING AND POPULATION GENETIC ANALYSIS

*Robert B. Page[1], **Jared P. Wood[2]**, Stephanie A. Dowell[3], and Todd S. Campbell[4]*
[1]Texas A&M University – San Antonio, San Antonio, TX, USA
[2]Southwestern Adventist University, Keene, TX, USA
[3]Fordham University, New York, NY, USA
[4]University of Tampa, Tampa, FL, USA

Invasive species are widely recognized as important drivers of the ongoing biodiversity crisis. The US state of Florida is especially susceptible to the proliferation of invasive reptiles, and nonnative lizards currently outnumber native lizard species. At present, there are 3 documented breeding populations of the Nile monitor (*Varanus niloticus*) and 2 documented populations of the Argentine black-and-white tegu (*Salvator merianae*) in different regions of Southern Florida. Both of these species are considered potential dangers to threatened, fossorial endemics, such as burrowing owls, American crocodiles, and gopher tortoises. Nevertheless, at present, the introduction histories of these species and the degree to which their respective populations are connected by gene flow are not known. To address these issues, we used microsatellites to conduct a variety of analyses to assess both intrapopulation genetic diversity, the degree of gene flow between populations, and the most likely introduction scenarios for both species. Regarding Nile monitors, the results of our analyses demonstrate that all 3 populations have limited genetic diversity and are highly differentiated from one another. Our results also suggest that these populations resulted from independent introduction events that occurred within the past few decades. Regarding Argentine black-and-white tegu populations, we also found evidence of limited genetic diversity and significant levels of population differentiation. However, we also found evidence of admixture, and our introduction analyses suggest that both populations originated from an unknown “ghost” population. We recommend that managers focus on containment rather than eradication strategies, and increase monitoring efforts of the pet trade and potential migration corridors.

BIO: Dr. Page is an Assistant Professor at Texas A&M University—San Antonio and has over 15 years of experience as a research scientist. Dr. Page is an evolutionary geneticist & ecologist by training and has published over 20 scientific articles on various aspects of genetics, genomics, ecology, behavior, and conservation.

Contact Information: Robert B. Page, Department of Science & Mathematics, Texas A&M University—San Antonio, One University Way, San Antonio TX 78224, Phone: 210-784-2267, email: Robert.Page@tamusa.edu

TIME-LAPSE GEOPHYSICAL MEASUREMENTS TARGETING SPATIAL AND TEMPORAL VARIABILITY IN BIOGENIC GAS PRODUCTION FROM EVERGLADES PEAT SOILS AT THE LOXAHATCHEE IMPOUNDMENT LANDSCAPE ASSESSMENT (LILA)

*Xavier Comas, **William Wright**, Thomas Shahan, and Nathan Sharp*
Florida Atlantic University, Boca Raton, FL

Peat soils are known to release globally significant amounts of methane (CH_4) and carbon dioxide (CO_2) to the atmosphere. However, uncertainties still remain regarding the spatio-temporal distribution of gas accumulations and triggering mechanisms of gas releasing events. Furthermore, most research on peatland gas dynamics has traditionally been focused on high latitude peatlands. As such, understanding gas dynamics in low-latitude peatlands such as the Florida Everglades is key to global climate research. Recent studies in the Everglades have demonstrated that biogenic gas flux values vary when considering different temporal and spatial scales of measurements, and the work presented here targets spatial variability in gas production and release at the plot scale in an approximately 85 m^2 area, and targets temporal variability with data collected during the spring months of two different years. This study is located in the Loxahatchee Impoundment Landscape Assessment (LILA), a hydrologically controlled, landscape scale (30 Ha) model of the Florida Everglades. Ground penetrating radar (GPR) has been used in the past to investigate biogenic gas dynamics in peat soils, and is used in this study to monitor changes of in situ gas storage. For each year of the project, a weekly grid of GPR profiles was collected to image changes in gas distribution in 2d, and several flux chambers outfitted with time-lapse cameras captured gas flux measurements inside the GPR grid. Seasonal and spatial dynamics are seen, with relationships between environmental conditions and methane release.

<u>Contact Information</u>: William Wright, Florida Atlantic University, 777 Glades Road, Boca Raton, FL, USA 33431, Phone: 772-538-1858, Email: wwrigh19@fau.edu

SIMULATING A CLASSIC STUDY OF PREY CONCENTRATION IN THE EVERGLADES IN SUPPORT OF LONG TERM DECISION STRATEGY

***Simeon Yurek**, and Donald DeAngelis*
U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

Simulation modeling was calibrated to a classic study of fish concentration at a pond in Big Cypress National Preserve, to understand interactions between fish movement behaviors, hydrology, and landscape pattern that result in high concentrations of fish during the wetland drying phase. These concentrations are hypothesized to be an important supplement to wading bird diets during the reproductive season, although linking hydrology to fish and bird population dynamics continues to be a challenge. One complicating factor is that water availability and water management needs vary from year to year, and combine to impact the annual hydrologic cycle. Predicting uncertainty around these interactions may be useful for future conservation and restoration planning.

Our goal was to quantify sensitivity of the fish concentration system to different management strategies under different scenarios of water availability, using computer simulation. Time series of real hydrologic and fish concentration data, collected in the 1970s, were used to validate the model. Then, artificial scenarios for landscape drying were developed. We found that the system is sensitive to both the rate of water level recession, and the lowest depth of water stage, and that these effects can carry across years. Finally, we describe this system with a simple trigonometric model that may be useful for application to other restoration projects. This study demonstrates that revisiting the past with new technology can provide insights into landscape processes. We suggest “concentration mechanisms” as a potential new target for conservation and restoration planning.

BIO: Dr. Yurek is an ecologist with the USGS with over 10 years of experience in wetlands and fish ecology and restoration. He applies landscape and systems approaches for spatial conservation planning.

Contact Information: Simeon Yurek, U.S. Geological Survey, 1751 Varsity Drive, Raleigh, NC, USA 27606-2576, Phone: 919-707-0118, Email: syurek@usgs.gov

HISTORICAL PERFORMANCE OF THE STA-3/4 PERIPHYTON-BASED STORMWATER TREATMENT AREA

Manuel F. Zamorano[1], *Tracey Piccone*[1], *and Kevin Grace*[2]
[1]South Florida Water Management District, West Palm Beach, FL, USA
[2]DB Environmental, Inc., Rockledge, FL, USA

The concept of using periphyton to cleanse stormwater prior to entering the Everglades has been investigated by South Florida Water Management District (SFWMD) scientists and other researchers for over twenty years. The STA-3/4 Periphyton-based Stormwater Treatment Area (PSTA) facility, located in southwestern Palm Beach County, FL, was constructed in 2005 to investigate the uncertainties associated with large-scale implementation of the PSTA technology. The PSTA Project is comprised of a 200-acre Upper submerged aquatic vegetation (SAV) Cell, a 100-acre Lower SAV Cell and a 100-acre PSTA Cell. The PSTA Cell is unique among STA treatment cells in that the extant peat was scraped to expose the underlying rock.

During the past eight years, the PSTA Cell has shown promising performance by achieving outflow flow-weighted mean (FWM) total phosphorus (TP) concentrations ranging from 8 to 13 µg L-1. In 2013, the SFWMD identified several key studies to be included as part of the comprehensive Restoration Strategies Science Plan implementation. One of these studies is the Investigation of STA-3/4 PSTA Performance Design and Operational Factors. The primary objective of this study is to address gaps in the current understanding of the PSTA technology related to design, operations, and sustainability.

This presentation summarizes the historical performance of the STA-3/4 PSTA Cell, as well as results of scientific studies that are being conducted in the cell to better understand the factors contributing to the cell's performance. Results to date indicate that the PSTA Cell's performance is not affected by short term hydraulic pulses, groundwater seepage, sediment accretion, and changes in average water depth.

BIO: Manuel "Felipe" Zamorano is an environmental scientist at the South Florida Water Management District with 14 years of experience working on the Everglades stormwater treatment areas (STAs). He is part of a team of scientists that monitor performance, evaluate, and implement ways to maximize phosphorus uptake in the STAs.

Contact Information: Manuel F. Zamorano, Water Quality Treatment Technologies, Applied Sciences Bureau, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406 USA, Phone: 561-686-8800 ext. 2654,
Email: mzamoran@sfwmd.gov

APPLICATION OF A DUAL-ISOTOPE MODEL IN THE SHARK RIVER SLOUGH WATERSHED: SEPARATING INCREASES IN SALINITY DUE TO SALTWATER INTRUSION FROM THAT DUE TO EVAPORATION

***Lu Zhai*[1,2]**, *Rafael Travieso*[3], *John S. Kominoski*[3], *Li Zhang*[4], *Evelyn E. Gaiser*[3], *Leonel Sternberg*[1]

[1]Department of Biology, University of Miami, Coral Gables, FL, USA
[2]Department of Mathematics, University of Miami, Coral Gables, FL, USA
[3]Department of Biological Sciences, Florida International University, Miami, FL, USA
[4]Everglades Wetland Research Park, Florida Gulf Coast University, Naples, FL, USA

Increased salinity of coastal ecosystems can occur through saltwater intrusion with storm surge and sea-level rise (SLR), and evaporation with global warming and higher incidences of drought. The effect of saltwater intrusion has received extensive research attention. However, there is no method to quantify the salinity increase caused by evaporation in coastal areas, because it is hard to separate and quantify the contributions from the two hydrological processes (i.e., saltwater intrusion and evaporation) to salinity increase. Here, we used a novel dual-stable isotopes ($\delta^{18}O$ and δD) based method to separate increases in salinity from saltwater intrusion and evaporation. The separating ability of our method is from that saltwater intrusion and evaporation increase $\delta^{18}O$ or δD values in water by different rates (i.e., different slopes of $\delta^{18}O$-δD lines for saltwater intrusion and evaporation, respectively). Our method was examined in the Shark River Slough (SRS) of Everglades by calculating the salinity contribution to brackish-water sites in SRS from the two hydrological processes. First, we sampled water from six points along SRS (i.e., a transect including six points (SRS 1-6) from ocean (brackish water) to inland (freshwater)) and one point in Mexico Gulf. Second, we quantified the evaporation of the brackish-water sites in SRS by the dual-isotope method. Finally, we quantified the contributions to the salinity of brackish-water sites from the two processes. Our sampling period covered both dry and wet seasons to examine the seasonal pattern of the salinity contributions. Our results showed that: (1) after mixing with saltwater, the salinities of brackish-water sites were significantly increased by evaporation; (2) the evaporation contribution had a clear seasonal pattern with higher values in dry seasons. Our study suggested that global warming can affect the biogeochemistry of costal ecosystems in a more complex way than simple saltwater intrusion. Coastal conservation projects aiming to decrease salinity increases will need to consider salinity increase due to evaporation in addition to saltwater intrusion.

<u>BIO</u>: Lu Zhai is a PhD candidate with research interests on using stable isotope technology, mathematic modelling, and GIS-RS method to understand sea level rise impacts on coastal ecosystems, including vegetation dynamics, hydrological cycle, etc.

<u>Contact Information</u>: Lu Zhai, Department of Biology, University of Miami, Coral Gables, FL, 33124. Phone: 305-284-2802, Email: zhailu@bio.miami.edu

QUANTIFYING SPATIAL RANGE OF SEA LEVEL RISE IMPACT ON VEGETATION COMMUNITY: A FIELD AND MODEL COMBINATION STUDY BASED ON CARBON STABLE ISOTOPE

Lu Zhai[1,2], *Xin Liu*[3], *Ken Krauss*[4], *Paul Conrads*[5], *Donald DeAngelis*[6], *Leonel Sternberg*[1]
[1]Department of Biology, University of Miami, Coral Gables, FL, USA
[2]Department of Mathematics, University of Miami, Coral Gables, FL, USA
[3]Co-Innovation Center for Sustainable Forestry in Southern China, Key Laboratory of Soil and Water Conservation and Ecological Restoration, Nanjing Forestry University, Nanjing, China
[4]Wetland and Aquatic Research Center, U.S. Geological Survey, Lafayette, LA, USA
[5]South Atlantic Water Science Center, U.S. Geological Survey, Columbia, SC, USA
[6]Wetland and Aquatic Research Center, U.S. Geological Survey, Gainesville, FL, USA

Sea level rise (SLR) impacts coastal vegetation communities by increasing salinity and inundation, but there are few simple and accurate methods to quantify the spatial range of the SLR impact on vegetation. Quantifying the spatial range of the SLR impact is important in ecological conservation. For example, it can be used to determine the location and size of natural reservoirs. In our study, SLR impact on vegetation was estimated by using leaf carbon isotope composition ($\delta^{13}C$) which increases with a greater growth stress associated with SLR. The leaf $\delta^{13}C$, as vegetation response to SLR, was incorporated into a coupled hydrology-vegetation simulation model, MANHAM, which projects effects of soil salinity on halophyte-glycophyte competition, to quantify spatial range of the SLR impacts. Our modelling approach described an innovative method of using small-scale leaf physiology response to estimate large-scale vegetation community change by SLR impacts. The connection between the two-scale dynamics is established by soil salinity effects on leaf stomas and leaf $\delta^{13}C$ response to leaf stomas. In detail, higher salinity effect can decrease the opening of stomas, then the decreased opening leads to higher leaf $\delta^{13}C$ values. On the basis of the interaction among salinity, stomas and leaf $\delta^{13}C$, we proposed a new version of MANHAM, called stoma-isotope based MANHAM, to quantify spatial range of SLR impacts. In addition, we applied the model to a stressed pine forest (loblolly pine, *Pinus taeda*) bordering the estuary of Waccamaw River in South Carolina. We sampled leaf, stem, soil and surface water samples along a transect from riverside (exposing to salinity stress) to inland areas (low salinity stress), and the leaf $\delta^{13}C$ responses along the above transect with its associated gradient in salinity were simulated by the stoma-isotope based model. Our study found that: (1) field observation indicate that leaf $\delta^{13}C$ values decreased from inland to riverside, (2) the model showed a good agreement with the observed leaf $\delta^{13}C$ pattern along the transect, and estimated threshold value of distance to river where the leaf $\delta^{13}C$ response to SLR impact disappeared. Based on the same leaf $\delta^{13}C$ pattern from both field and model study, our estimated threshold value of SLR impact spatial range can lead to a more informed conservation management.

BIO: Lu Zhai is a PhD candidate with research interests on using stable isotope technology, mathematic modelling, and GIS-RS method to understand sea level rise impacts on coastal ecosystems, including vegetation dynamics, hydrological cycle, etc.

Contact Information: Lu Zhai, Department of Biology, University of Miami, Coral Gables, FL, 33124. Phone: 305-284-2802, Email: zhailu@bio.miami.edu

SIMULATING THE IMPACT OF BIOLOGICAL CONTROL ON AN INVASIVE PLANT BY USING AN INDIVIDUAL BASED MODEL (JABOWA)

***Bo Zhang*[1]**, *Donald L. DeAngelis*[2], *Min B. Rayamajhi*[3], *Daniel Botkin*[4]
[1]Department of Biology, University of Miami, Coral Gables, FL, USA
[2]U. S. Geological Survey, Wetlands and Aquatic Research Center, Gainesville, FL, USA
[3]USDA-ARS Aquatic Weed Research Laboratory, Fort Lauderdale, FL, USA
[4]Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, CA, USA

Melaleuca quinquenervia (Cav.) Blake (hereafter melaleuca) is an invasive tree from Australia that has spread over the freshwater ecosystems of southern Florida, displacing native vegetation, thus threatening native biodiversity. Suppression of melaleuca appears to be progressing through the introduction of biological control, the weevil, *Oxiops vitiosa*, and the psyllid, *Boreioglycaspis melaleucae*. Based on the previous field study, we understood that such biological control can successfully decrease about 49% of melaleuca's maximum reproduction rate and 83% of its maximum growth rate. Therefore, this pilot study aimed to use an individual based forest modeling platform, JABOWA-II, to project the future changes in plant communities in the typical wetland habitats mainly located in southern Florida.

JABAWO-II is an established modeling platform that has been broadly applied on many problems in forest ecology, due to its successful and accurate simulation of forest dynamics over long periods of time. This model includes three main processes of each individual stem within the simulated plot; growth, mortality and reproduction. All individuals are competing for the available light. Furthermore, this model can simulate environmental conditions, via particular site information, such as temperature, precipitation, water depth, and soil nutrient content.

We projected likely future changes in plant communities occurring in two typical habitats in southern Florida, cypress swamp and bay swamp. Within each habitat, we included both native species (such as cypress, slash pine, sweet bay) and melaleuca, and we simulated the scenarios with and without the impact of biological control for each habitat. Computer simulations showed melaleuca invasion led to decreases in density and basal area of native species, but herbivory would effectively control melaleuca to low levels, resulting in a recovery of native species. Sensitivity analysis suggested that reductions on reproduction and growth should be kept at levels of 49% and 83% or greater, respectively, to have to level of effects shown in our simulations.

This study was one of the first we know of to apply individual based model to invasive species management and we believe that this type of model might be a useful tool to predict the long-term impact of such control on performance of other invasive species, such as Chinese tallow, or be applied to different vegetation habitats, by giving different site information, or further be used to project the effects of other types of treatment on invasive species, such as fire, chemical pesticide.

BIO: Bo Zhang is a PhD candidate in Dr. Donald DeAngelis' lab. She in broadly interested in forest ecology, especially by combining both field work data and mathematical simulation to understand the response of certain forest to climate change impact, human disturbance.

Contact Information: Bo Zhang, Department of Biology, 1301 Memorial Drive, Coral Gables, FL 33124. Phone: 786-863-6669, Email: bo@bio.miami.edu

APPLYING TIME SERIES LANDSAT DATA FOR VEGETATION CHANGE ANALYSIS IN THE FLORIDA EVERGLADES WATER CONSERVATION AREA 2A DURING 1996-2016

Caiyun Zhang
Florida Atlantic University, Boca Raton, FL, USA

Mapping plant communities and documenting their changes is critical to the on-going Florida Everglades restoration project. In this study, a framework was designed to map dominant vegetation communities and inventory their changes in the Florida Everglades Water Conservation Area 2A (WCA-2A) using time series Landsat images spanning 1996 to 2016. The object-based change analysis technique was combined in the framework. A hybrid pixel/object-based change detection approach was developed to effectively collect training samples for historical images with sparse reference data. An object-based quantification approach was also developed to assess the expansion/reduction of a specific class such as cattail (an invasive species in the Everglades) from the object-based classifications of two dates of imagery. The study confirmed the results in the literature that cattail was largely expanded during 1996-2007. It also revealed that cattail expansion was constrained after 2007. Application of time series Landsat data is valuable to document vegetation changes for the WCA-2A impoundment. The digital techniques developed will benefit global wetland mapping and change analysis in general, and the Florida Everglades WCA-2A in particular.

BIO: Dr. Zhang is an associate professor at the Florida Atlantic University working in remote sensing. Her recent research focuses on remote sensing data fusion for vegetation mapping in the Florida Everglades. She has published 7 peer-reviewed journal articles in this field since 2012.

Contact Information: Caiyun Zhang, Department of Geosciences, Florida Atlantic University, Boca Raton, FL, USA 33431,
Phone: 561-297-2648, Email: czhang3@fau.edu

INVESTIGATE SPATIAL DIFFERENCES IN FLOODING RISK ASSOCIATED WITH RAINFALL AND CANAL WATER STAGE IN THE C-111 AGRICULTURAL BASIN

Meijing Zhang[1], *Kati W. Migliaccio*[2] *and Young Gu Her*[1]
[1]University of Florida, Homestead, FL, USA
[2]University of Florida, Gainesville, FL, USA

As part of the Comprehensive Everglades Restoration Plan (CERP), C-111 spreader canal project was designed to restore the natural ecosystem that was negatively impacted by an extensive C-111 canal network. C-111 project was originally constructed to allow for development and provide flood protection and drainage for agricultural areas along the east side of Everglades National Park (ENP). The study purpose was to investigate spatial differences in flooding risk associated with rainfall and canal water stage within the study area and to gain understanding on the benefits of different canal management practices and drainage characteristics of the system. MODFLOW-2005 was used to simulate the Biscayne aquifer flow system in the study area. Canals were simulated with the Surface Water Routing (SWR) package. Surface-water flow between canals were simulated by the diffusive-wave approximation of the Saint-Venant equations. Simulation results indicated that the developed model was able to reproduce measured groundwater levels in observation wells and flow rate in canals quite well. Scenarios were set up to investigate the effects of structural modification and operational adjustment on water table response and flood risk. With the modification of canal structure and operation adjustment, significant difference was observed in water table response in some wells. On average, water table response height and flood risk were lower after than before the structure modification to canals. This study highlights the benefit of an integrated hydrological model to the water resources management in South Florida for the period 2010 to 2016.

BIO: Dr. Zhang is a Postdoctoral Research Associate at the University of Florida. She has extensive experience with hydrogeological and hydrological modeling.

Contact Information: Dr. Kati White Migliaccio, Department of Agricultural and Biological Engineering, 273 Frazier Rogers Hall , PO Box 110570 Gainesville, FL 32611, Phone: 352-392-1864 ext. 273, Email: klwhite@ufl.edu

A SYSTEMATIC APPROACH IN EVALUATING THE SOURCE/SINK BEHAVIORS FOR WATER QUALITY PARAMETERS IN AN STA CANAL

Hongying Zhao, *Tracey Piccone, and Steven Hill*
South Florida Water Management District, West Palm Beach, FL, USA

The Everglades Stormwater Treatment Areas (STAs), located in Palm Beach County, FL, were constructed and are operated to reduce total phosphorus (TP) in runoff water. In an effort to further optimize the performance of the STAs and meet stringent regulatory limits, the South Florida Water Management District (SFWMD) has been conducting scientific investigations that could provide inputs to new or enhanced management and operational strategies. This particular study is to investigate the role of inflow and outflow canals on STA performance.

This study focused on the evaluation of the nutrient release and retention within the Stormwater Treatment Area 1 (STA-1) Inflow Basin Canal segment from pump station S-5A (the canal inflow structure) to structure G-302 (the canal outflow structure). The evaluation was conducted using existing water quality and flow data to determine if TP concentrations change when conveyed along a canal and, if concentrations do change, determine how much TP load is exported from or accumulated in the canal over the analysis period. Load and concentration-based analyses at different temporal scales, and a suite of statistical analysis techniques including descriptive statistics, data plots, t-test, Wilcoxon Signed-Rank test, correlation and regression analyses, and partition analysis were used.

Good mass conservation of flow and agreement on Chloride values between S-5A and G-302 validated the effectiveness of load-based mass balance analyses. The evaluation suggested that the canal behaved as a source of TP over the period analyzed. The TP load exported from the canal during a period of 13 years was approximately 70 tons. Concentrations of TP at G-302 were significantly higher than the concentrations at the upstream structure (S-5A). The results also suggested that a majority of the TP load exported from the canal was in the form of particulate P and that flow velocity was a major influencing factor. The results also suggested that a majority of the TP load exported from the canal was in the form of particulate phosphorous (PP). Additional analyses suggested that velocity was a factor in TP concentration increase from the upstream structure to the downstream structure. The velocity-based results support the Restoration Strategies goal of providing Flow Equalization Basin upstream of the Stormwater Treatment Areas to reduce the frequency high flow events and attenuate peak flow rates.

BIO: Dr. Zhao is a Lead Engineer with about 20 years of experience in hydrology and hydraulic modeling, stormwater management system designing and permitting, basin management, Stormwater Treatment Area performance evaluation. She is familiar with different structures and operations of five Everglades Stormwater Treatment Areas.

Contact Information: Hongying Zhao, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406, Phone: 561-6026090, Email: hzhao@sfwmd.gov

PHOTOSYNTHETIC ACTIVITY OF C_3 AND C_4 GRAMINOIDS IN RESPONSE TO WATER TABLE CHANGE IN A SHORT-HYDROPERIOD WETLAND OF THE FLORIDA EVERGLADES

Junbin Zhao[1], *Steven F. Oberbauer*[1], *Paulo C. Olivas*[1], *Jessica L. Schedlbauer*[1,2], *Jonathan G. Moser*[1], *and Gregory Starr*[3]

[1]Florida International University, Miami, FL, USA
[2]West Chester University, West Chester, PA, USA
[3]University of Alabama, AL, USA

Short-hydroperiod marsh of the Everglades is dominated by a mix of sawgrass (*Cladium jamaicense*, a C_3 sedge) and Muhly grass (*Muhlenbergia capillaris*, a C_4 grass). Water levels in marl prairies are strongly seasonal in response to water management and rainfall, with water tables down to 80cm below the surface for approximately 6-7 months during the dry season and up to 40cm above the surface during the wet season. Previous eddy covariance studies from this habitat revealed strong reductions in CO_2 uptake coinciding with water tables inundating the surface during wet seasons. This reduction of CO_2 uptake is partly due to the submersion of macrophyte leaf area. Whether a reduction in plant photosynthetic capacity, as a result of the inundation, also contributes to the CO_2 uptake reduction still needs to be investigated. Our hypothesis is that plants would down regulate their stomatal conductance under the stress of inundation and reduce photosynthetic capacity. To test this hypothesis, we measured maximum assimilation rates (A_{max}) of the dominant species during wet and dry seasons over 4 years in the marsh and on a nearby levee, where water table is on average 30cm lower than the marsh. As a typical C_4 plant, A_{max} of *Muhlenbergia* were > 20μmol m^{-2} s^{-1} during the dry season; while the Amax of *Cladium*, a C_3 plant, were ~15μmol m^{-2} s^{-1}. No significant difference between marsh and levee was observed in A_{max} of both species during the dry season. During the wet season, A_{max} of emergent leaves of *Cladium* were still lower overall and did not show differences between the marsh and levee. However, A_{max} of emergent leaves of the *Muhlenbergia* were significantly reduced in marsh compared to those in the levee. Contrary to our hypothesis, stomatal conductances did not show a significant reduction in the marsh compared to those the levee for both species, indicating other physiological processes rather than stomatal control is responsible for the A_{max} reduction of C_4 plants when submerged. We suspect the stress from root oxygen deprivation may be one cause for the A_{max} reduction. In addition, as another potential explanation, a significantly lower nitrogen (N) concentration was found within the leaves of *Muhlenbergia* in the marsh than on the levee during the wet season, even though more N was present in the soil of the marsh than the levee. This wetland represents an unusual situation whereby one of the co-dominants is effectively photosynthetically inactive during wet season. Planned changes to increase water flow to the Everglades and predicted changes in rainfall with climate change will strongly affect the carbon balance of this habitat.

BIO: Junbin Zhao is a postdoctoral associate working on a project regarding greenhouse gas emission in the Everglades wetlands. He has years of experiences in studying wetland CO_2 and CH_4 exchange at ecosystem and plant scale.

Contact Information: Junbin Zhao, Department of Biology, Florida International University, 11200 SW 8th ST, Miami, FL, 33199, Phone: 305-348-6707, Email: juzhao@fiu.edu

GREENHOUSE GAS EMISSIONS FROM THE HERBACEOUS PEATLAND

Xiaoyan Zhu[1,2,3], *Changchun Song*[2], *Yuncong Li*[1] *and Young Gu Her*[1]
[1]University of Florida, Tropical Research and Education Center, Homestead, FL, USA
[2]Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, IGA, China
[3]Univeristy of Jilin Jianzhu, Changchun, JLJU, China

Peatlands, the primary pool of organic carbon in the earth, are extended over vast areas in the northern hemisphere. The carbon sink of peatlands has changed or will change, which is affected by future climatic variability and increasing human disturbance. Then, the changes in the carbon sink influence on future climate. Thus, understanding the dynamic feedback and control mechanism of greenhouse gases is important to accurately estimate carbon emissions and predict the changes in the contact of climate change. We monitored the temporal dynamics of greenhouse gas emissions from a *Carex lasiocarpa* dominated peatland in the field of the Sanjiang Plain, China to investigate the influence of precipitation and climate changes on controlling greenhouse gases emissions. The main findings are that:
(1) The greenhouse gas emissions of herbaceous peatland in the Sanjiang Plain showed significant temporal patterns during the three years measurement (2012-2014). Ground water table and temperature are the main factors controlling the greenhouse gas emissions.
(2) There were significant differences in the dissolved porewater methane concentrations of the vertical profile. There was strong statistical relationship between the methane concentrations in a surface layer (5-10cm) and CH_4 emissions. The methane concentrations in the surface layer controlled 26-60% of the seasonal variations in methane emissions. Meanwhile, rapid and short-lived precipitation events might have no immediate influence on CH_4 concentration.
(3) The mean Q_{10} values ranged from 2.1 to 2.9 depending on the soil depths where soil temperature was measured. Soil respiration played a major role in peatland carbon balance, and it accounted for 57% of ecosystem respiration in 2012 and 2013. The Q_{10} value (of 2.9) at the 10cm depth appears to be a good representation for herbaceous peatland in the Sanjiang Plain when applying field-estimation based Q10 values to current terrestrial ecosystem models due to the most optimized regression coefficient (73.7%).
(4) The alternation between drying and wetting produced CH_4 emission pulses in the two drying-wetting cycles. Methane fluxes in the mesocosms exposed to periodic wetting and drying increased greenhouse gas emission and its variability compared to the case of the constant water table.
(5) The increase temperature (Open Top Chamber) had no significant influence on greenhouse gas emission in the *Carex Lasiocarpa*-dominated peatland ($P>0.05$). This may be explained by the significant changes of soil moisture in the open top chamber, which may cover the differences in CH_4 emissions inside and outside the open top chamber. The fire increased 54% of the aboveground biomass of *Carex Lasiocarpa*, which then increased the ecosystem respiration.

Emphasis on greenhouse gas emissions from temperate peatlands in the Sanjiang Plain will improve our basic understanding of carbon exchange between peatland ecosystem and the atmosphere.

BIO: Dr. Zhu is a post-doctoral fellow from China Academy of Science and now she is a research scholar in University of Florida. She dose research in greenhouse gas emissions in wetland. She has published more than 10 papers and leads two projects dedicated to wetlands carbon cycle.

Contact Information: Xiaoyan Zhu, Tropical Research and Education Center, 18905 SW 280th Street, FL, USA 33031, Phone: 786-280-0121, Email: zhuxiaoyan@iga.ac.cn

NEARSHORE PINK SHRIMP DENSITIES RELATIVE TO HABITAT LIMITATIONS IN BISCAYNE BAY: A SPATIOTEMPORAL ANALYSIS OF 10 YEARS OF DATA

***Ian C. Zink*[1,2]**, *Joan A. Browder*[2], *Diego Lirman*[1], *Joseph E. Serafy*[1,2]
[1]University of Miami, Coral Gables, FL, USA
[2]NOAA NMFS SEFSC, Miami, FL, USA

The pink shrimp (*Farfantepeneaus duorarum*) has been selected by the South Florida Ecosystem Restoration Task Force as an indicator species to gauge the success of Comprehensive Everglades Restoration Plan (CERP) implementation in the Southern Coastal Systems. In southern Biscayne Bay, CERP is anticipated to lower mean salinity conditions while also reducing salinity fluctuation by redistributing coastal inflows from point-source discharges (i.e., canal mouths) to restored alongshore areas, allowing for more dispersed inflow along a greater extent of the shoreline. Pink shrimp abundance has been monitored biannually ('dry' and 'wet' seasons) along the western mainland shoreline of southern Biscayne Bay using a 1 m^2 throw trap continuously since 2005 and more recently (since 2012) as part of the Integrated Biscayne Bay Ecological Assessment and Monitoring program. Each site sampling event includes measurement of water quality parameters (temperature [°C], salinity [ppt]), water depth (m), benthic habitat characteristics (presence and percent cover of seagrasses and macroaglal spp.). Quantile regression with linear and quadratic functional forms was used to find environmental conditions which limit pink shrimp density (shrimp m^{-2}). Results indicated that temperatures below 18 °C and above 33°C, salinities below 15 ppt, depths below 0.2 m and above 1.1 m, and submerged aquatic vegetation (SAV) cover below 25% limited pink shrimp density. Hierarchical agglomerative clustering using Ward's method followed by similarity profiling permutations were used to identify groups of sites and year/season whose shrimp density patterns were similar. Kruskal-Wallis testing noted significant differences of density, salinity and SAV cover among sampling site clusters. Among year-season clusters; density, temperature, salinity, depth, and SAV cover were found to significantly differ. Bonferroni-adjusted Nemenyi pairwise revealed significant differences between cluster pairs within sites and year-season analyses. However, median differences were so small that they seemed ecologically meaningless and Kruskal-Wallis significant results were more likely due to differences in distribution shapes and ranges. These results are discussed in terms of pink shrimp and salinity targets for southern Biscayne Bay.

BIO: Mr. Zink is a PhD student at the University of Miami RSMAS and has worked as a contractor to NOAA NMFS for the past 6 years. In this capacity, he has assisted and developed field and laboratory studies as well as led monitoring of pink shrimp and related seagrass/mangrove ecosystems.

Contact Information: Ian C. Zink, U. of Miami CIMAS/NOAA Affiliate – NOAA NMFS Southeast Fisheries Science Center: 75 Virginia Key Beach Dr., Miami, FL 33149 Office: 305-361-4297, Email: izink@rsmas.miami.edu

SCALING ACTIVE MANAGEMENT

***Christa Zweig**, Susan Newman, Colin Saunders, and Fred Sklar*
South Florida Water Management District, West Palm Beach, FL, USA

In ecological restoration, many ecosystems are so different from their original state that simply changing ecological drivers will not restore the landscape. The ridge and slough landscape of the Florida Everglades is an excellent example where the loss of landscape pattern may not be reversed by restoring historical flow, depth, and or hydroperiod. Particularly in over-drained areas, established sawgrass (*Cladium jamaicense*) can persist for decades in sub-optimal, wetter conditions. We had the opportunity to perform active management within an experimental flow footprint (Decomp physical model) in the Everglades, to test the feasibility and benefit of creating new sloughs to increase the velocity and spatial extent of flow through the wetland. Flows in the active management sites were significantly higher than the surrounding ridge: maximum of 16 cm/sec versus 3.5 cm/sec, and flows in the slough downstream were higher than the upstream slough. The active management also conducted flow in a different direction than water in the surrounding ridge, but still exchanged flow and sediment with the ridge. Submerged aquatic plants grew in the new slough during the non-flow months and no sawgrass was able to reinvade—it is now functioning as an open-water slough. Our field results suggest that propagating flow further into a landscape is possible through active management, so we modeled the possibility of large-scale active management to affect water flow direction and speed at a landscape level. From the results of the model, landscape level active management has been implemented in the DPM footprint.

BIO: Dr. Zweig is a scientist with the South Florida Water Management District and has 16 years of experience working in the Everglades.

Contact Information: Christa Zweig, South Florida Water Management District, Field Operations Center, 8894 Belvedere Road, West Palm Beach, FL 33411, Phone: 561-682-4547, Email: czweig@sfwmd.gov

Thank You Sponsors

UF|IFAS
UNIVERSITY of FLORIDA

Office of Conferences and Institutes
2311 Mowry Road, Bldg. 78 / PO Box 110750
Gainesville, FL 32611
Phone: (352) 392-5930 | www.conference.ifas.ufl.edu