FLORIDA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

Annual Report 2024

FLORIDA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

PO Box 110485
2295 Mowry Rd, Bldg. 106
University of Florida
Gainesville, FL 32611-0485

Cooperators

Florida Fish and Wildlife Conservation Commission

United States Geological Survey

United States Fish and Wildlife Service

University of Florida

Wildlife Management Institute

Cover: *Little Orange Creek. MADISON HEISEY*
Top Left: *Canon netting red knots at Fort DeSoto Park. ABBY POWELL*
Top Right: *A female scout python in Big Cypress National Preserve is pictured on top of her nest that she laid in May 2024. LISA M. MCBRIDE*
Bottom Left: *Everglades Biocorps Intern, Grace Schuppie, participating in alligator surveys in Everglades National Park. UNKNOWN*
Bottom Right: *First-year barred owl at Kissimmee Prairie Preserve State Park. MADISON HEISEY*

Table of Contents

TOP RIGHT: *Ray Carthy, Jazmyn Broxton, Christina Romagosa and Ben Kahler - Coop Unit Booth at the 2024 Mowry Road Roadshow. ABBY POWELL*
MIDDLE RIGHT: *UF intern Camille Klemman and Cherokee Nation System Solutions (CNSS) technician Judith Baird Lujano holding a male scout python "CS". ENRIQUE RIBAS*
BOTTOM RIGHT: *Bluenose Shiner. KYLE MILLER*
BOTTOM LEFT: *Costanza Manes releasing a green turtle. EVAN COOPER*

Acronyms

ARM	Arthur R. Marshall
CHANS	Coupled Human and Natural Systems
CRU	Cooperative Research Units, U. S. Geological Survey
DDCSP	Doris Duke Conservation Scholars Program
FAS	Fisheries & Aquatic Sciences, School of Forest, Fisheries, & Geomatics Sciences, University of Florida
FORT	Fort Collins Science Center, U. S. Geological Survey
FP	Fibropapillomatosis
FWC	Florida Fish and Wildlife Conservation Commission
GIS	Geographic Information System
NOAA	National Oceanic and Atmospheric Administration
NPS	U. S. National Park Service
NSF	National Science Foundation
PDARP	Programmatic Damage Assessment and Restoration Plan, U. S. Department of the Interior
RWO	Research Work Order
SFWMD	South Florida Water Management District
SNRE	School of Natural Resources and Environment, University of Florida
SSA	Species Survival Assessment
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UF	University of Florida
USFWS	U. S. Fish and Wildlife Service
USGS	U. S. Geological Survey
WARC	Wetland and Aquatic Research Center, U. S. Geological Survey
WEC	Department of Wildlife Ecology and Conservation, University of Florida

Introduction

The Florida Cooperative Fish and Wildlife Research Unit was established in 1979 as one of the first combined units. The purpose of the Florida Unit is to provide for active cooperation in the advancement, organization, and conduct of scholarly research and training in the field of fish and wildlife sciences, principally through graduate education and research at the University of Florida. The Florida Unit has the mission to study wetland ecosystems within the state. Florida is a low relief, sub-tropical peninsula that is ecologically fragile. Though abundant, Florida's water resources are under increasing pressure from a burgeoning human population. Domestic, recreational, and development needs threaten Florida's water/wetland resources. In following its program directive, the Florida Unit has developed a research program that addresses management issues with approaches spanning species to ecosystem perspectives. Specifically, this Unit conducts detailed investigations of aquatic-terrestrial ecosystem interfaces and their component fish and wildlife resources.

Florida Unit quarters at 2295 Mowry Road, University of Florida. RAYMOND CARTHY and ANDREW ORTEGA using an Unmanned Aircraft System drone.

Between 1979 and 2024, over 340 projects totaling more than $70 million were funded through the Unit. These projects covered a wide variety of fish, wildlife, and ecosystem subjects and have involved over 50 line, affiliate, and adjunct faculty members as principal and co-principal investigators. Unit staff have their own research projects, which accounted for about 1/3 of the total effort. Projects associated with the Unit have resulted in over 500 publications, 150 technical reports, 120 theses and dissertations, and 300 presentations. Cooperation has been the Florida Unit's strength. As a Cooperative Research Unit of the U.S. Geological Survey, it serves as a bridge among the principal cooperators, such as the University of Florida, the Florida Fish and Wildlife Conservation Commission the U.S. Geological Survey, the U.S. Fish and Wildlife Service and the community of state and federal conservation agencies and nongovernmental organizations. Evidence of this role is the Unit's funding which has included contributions from FWC, 12 U.S. National Park Service Biological Resources Division research labs and centers, 12 offices within the USFWS Southeast Region, the University of Florida, U.S. Army Corps of Engineers, U.S. Navy, U.S. Department of Agriculture, U.S. Air Force, U.S. National Park Service, Environmental Protection Agency, St. Johns River Water Management District, South Florida Water Management District, U.S. Agency of International Development, World Wildlife Fund, the Nature Conservancy, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Florida Wildlife Federation, National Audubon Society, Florida Alligator Farmers' Association, American Alligator Farmers' Association, Florida Fur Trappers' Association, and other private contributions. Many Unit projects involve multiple investigators from several agencies. This cooperative interaction stimulates continuing involvement of funding sources, provides for student contacts with potential employers and agency perspectives, and directs transfer and application of research results.

Mission Statement

The mission of the Florida Cooperative Fish and Wildlife Research Unit is to conduct detailed investigation of aquatic and terrestrial resources and their component fish and wildlife populations. Our research emphasizes the interaction of biota with features of their habitat, both natural and those impacted by human activities, and ranges across state, regional, national, and international scopes. We have wide-ranging expertise in avian ecology and conservation, endangered species monitoring and assessment, coastal ecosystems, population and ecological modeling, decision analysis, fisheries ecology and management, and coupled human and natural systems.

Our research is taxonomically diverse, including but not limited to terrestrial and water birds, terrestrial herpetofauna and marine turtles, and freshwater and marine fishes. Critical components of our mission include applied research, graduate education, and technical assistance in collaboration with the Florida Fish and Wildlife Conservation Commission, U. S. Geological Survey, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and many other partners.

In Dedication to Dr. Eric Hellgren

This year we dedicate our annual report to Department Chair and strong advocate for the Cooperative Research Units (CRUs), Dr. Eric Hellgren. Eric's academic background includes a long history of familiarity and interaction with CRUs. Two of his former alma maters hosted CRUs: Colorado State University (B.S.) and Virginia Polytechnic Institute (Ph.D.); his doctoral advisor served as the Unit Leader of the Virginia CRU. Eric also served as a faculty member in another university that hosted a unit – Oklahoma State University. Thus, when he became department chair of Wildlife Ecology and Conservation at University of Florida in 2013, he was already a strong proponent of the units and their mission to conduct research and address the needs of their state and federal partners, educate graduate students in wildlife and fisheries, and provide technical assistance to cooperating agencies.

We greatly appreciate Eric's understanding and advocating for the Florida Unit, especially during times of uncertainty and administrative changes. As Secretary/Treasurer of the National Association of University Fisheries and Wildlife Programs, he has actively advanced support for the CRUs on a national level. This has been particularly important the past few months, when the fate of the CRUs nationwide has been become tenuous. Within the University of Florida, Eric's support includes growing the Unit from two to four scientists, finding the Unit a new home on Mowry Road, helping us remodel the graduate student space in the building, helping support our graduate students, and contributing to our annual Coordinating Committee Meeting (thank him for that beer!).

Eric will be stepping down as Department Chair this summer and will be joining us in our building until he retires — completing the circle from graduate school to retirement at a CRU! Congratulations and heartfelt thanks from your Federal partners.

Unit Coordinating Committee

Scott Angle
Senior Vice President, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida.

Gil McRae
Director, Fish and Wildlife Research Institute, FWC, St. Petersburg, Florida.

Elizabeth Webb
Southeastern Supervisor, Cooperative Fish and Wildlife Research Unit Program, USGS, Columbia, Missouri.

Jonathan Gassett
Southeastern Field Representative, Wildlife Management Institute, Georgetown, Kentucky.

Kevin Kalasz
Coastal Program Coordinator, Ecological Services, USFWS, Big Pine, Florida.

Biographical Profiles of Unit Scientists

Abby Powell – Unit Leader, Courtesy Professor, Department of Wildlife Ecology and Conservation and College of Natural Resources and the Environment at the University of Florida.
Dr. Powell is an avian ecologist, with research interests in population and movement ecology of birds, including but not limited to endangered and threatened species. Her work is directly related to conservation and management issued and includes breeding and overwintering biology and habitat use, as well as migration ecology.

Raymond R. Carthy – Assistant Unit Leader, Courtesy Professor, Department of Wildlife Ecology and Conservation and College of Natural Resources and the Environment at the University of Florida.
Dr. Carthy's research centers on the ecology of federally listed species, including reproductive ecology and physiology of coastal and wetland herpetofauna, with a current focus on marine turtles and manatees. He is also involved in research on threatened upland species, conservation management-oriented studies, and is the Program Director/Wildlife Lead for the UF Uncrewed Aircraft Systems Research Program.

Conor McGowan – Assistant Unit Leader, Courtesy Associate Professor, Department of Wildlife Ecology and Conservation and College of Natural Resources and the Environment at the University of Florida.
Dr. McGowan's research and teaching interests are in decision support science (especially endangered species decision making), population dynamics, predictive modeling of species status, harvest decision modeling, and quantitative methods for population assessment.

Andrew Carlson – Assistant Unit Leader, Courtesy Assistant Professor, Fisheries and Aquatic Sciences at the University of Florida.
Dr. Carlson explores fisheries as ecosystems, human systems, and coupled human-natural systems. From sport fish to imperiled species, his lab studies fishes and their habitats to develop strategies for sustaining fish production and biodiversity, particularly amid stressors such as land-use change, species invasion, and groundwater withdrawal. He also studies other aquatic organisms, human systems, and coupled human-natural systems to design aquatic resource management approaches that incorporate perspectives of diverse user groups.

Cooperators

Nathan Allan, *U.S. Fish and Wildlife Service*

Micheal S. Allen, *University of Florida*

Gretchen Anderson, *U.S. Geological Survey*

Christine Angelini, *University of Florida*

Gènesis Aponte-Santiago, *U.S Geological Survey*

Joe Aufmuth, *University of Florida*

Nick Aumen, *U.S. Geological Survey*

Juditch Baird-Lujano, *U.S. Geological Survey*

Benjamin Baiser, *University of Florida*

Brandon Baker, *Georgia Department of Natural Resources*

Ian Bartoszek, *Conservancy of Southwest Florida*

Tyler Beck, *Florida Fish and Wildlife Conservation Commission*

Mo Bennett, *University of Florida*

Arthur Bernhardt, *Florida Fish and Wildlife Conservation Commission*

Scott Bisping, *Florida Fish and Wildlife Conservation Commission*

Karen A. Bjorndal, *University of Florida*

Sean Blomquist , *U.S. Fish and Wildlife Service*

Rena Borkhataria, *University of Florida*

Robin Boughton, *Florida Fish and Wildlife Conservation Commission*

Laura Brandt, *U.S. Fish and Wildlife Service*

Anna Braswell, *University of Florida*

Billy Brooks, *U.S. Fish and Wildlife Service*

Janell Brush, *Florida Fish and Wildlife Conservation Commission*

Heather Bulger, *U.S. Army Corps of Engineers*

Kathleen Burchett, *U.S. Fish and Wildlife Service*

Matt Burgess, *U.S. Geological Survey*

Ed Camp, *University of Florida*

Cameron Carter, *University of Florida*

Zachary Chejanovski, *Florida Fish and Wildlife Conservation Commission*

Michael Cherkiss, *U.S. Geological Survey*

Matt Chopp, *U.S. Department of Argiculture*

Natalie Claunch, *U.S. Department of Argiculture*

Roger Clay, *Alabama Department of Conservation and Natural Resources*

Lew Coggins, *National Oceanic and Atmospheric Administration*

Jenna Cole, *South Florida Water Management District*

Andrew Cox, *U.S. Fish and Wildlife Service*

Chelsea Crandall, *Florida Fish and Wildlife Conservation Commission*

Andrea Currylow, *U.S. Geological Survey*

Wes Daniel, *U.S. Geological Survey*

Tylan Dean, *National Park Service*

Bon A. Dewitt, *University of Florida*

Kevin Donmoyer, *National Park Service*

Jason Dotson, *Florida Fish and Wildlife Conservation Commission*

Drew Dutterer, *Florida Fish and Wildlife Conservation Commission*

Michelina Dziadzio, *Florida Fish and Wildlife Conservation Commission*

Ian Easterling, *Conservancy of Southwest Florida*

Catherine Eastman, *University of Florida*

Deborah Epperson, *U.S. Geological Survey*

Nick Farmer, *National Oceanic and Atmospheric Administration*

Brian Folt, *U.S. Geological Survey*

Bradley Fontaine, *Florida Fish and Wildlife Conservation Commission*

Dewayne Fox, *Delaware State University*

Karen Frutchey, *U.S. Fish and Wildlife Service*

Mariana Fuentes, *Florida State University*

Sarah Funck, *Florida Fish and Wildlife Conservation Commission*

Victoria Garcia, *U.S. Fish and Wildlife Service*

Brian Garrett, *South Florida Water Management District*

Kelly Gestring, *Florida Fish and Wildlife Conservation Commission*

Rebekah Gibble, *U.S. Fish and Wildlife Service*

Jeff Gleason, *U.S. Fish and Wildlife Service*

Heather Goston, *Florida Department of Environmental Protection*

Andrew Gude, *U.S. Fish and Wildlife Service*

Darby Guyn, *City of Gainesville*

Jacquelyn Guzy, *U.S. Geological Survey*

Dianne Hall, *St. Johns Water Management District*

Marla Hamilton, *U.S. Fish and Wildlife Service*

Ryan Hamm, *Florida Fish and Wildlife Conservation Commission*

Kristen Hart, *U.S. Geological Survey*

Kate Healy, *U.S. Fish and Wildlife Service*

Brian Healy, *National Park Service*

Eric Hellgren, *University of Florida*

Joe Heublein, *National Oceanic and Atmospheric Administration*

Dave Hewitt, *U.S. Fish and Wildlife Service*

Jeff Hill, *University of Florida*

Tomo Hirama, *Florida Fish and Wildlife Conservation Commission*

Nathan Hostetter, *North Carolina Fish and Wildlife Research Unit*

Jamie Howard, *National Park Service*

Mark Hoyer, *University of Florida*

Vanessa Hull, *University of Florida*

Margaret Hunter, *U.S. Geological Survey*

Chuck Hunter, *U.S. Fish and Wildlife Service*

Reid Hyle, *Florida Fish and Wildlife Conservation Commission*

Peter Ifju, *University of Florida*

Steven Johnson, *University of Florida*

Kevin Johnson, *Florida Fish and Wildlife Conservation Commission*

Todd Jones-Farrand, *U.S. Fish and Wildlife Service*

Alyssa Jordan, *Florida Fish and Wildlife Conservation Commission*

Adam Kaeser, *U.S. Fish and Wildlife Service*

Kevin Kalasz, *U.S. Fish and Wildlife Service*

Patty Kelly, *U.S. Fish and Wildlife Service*

Catherine Kennedy, *Florida Fish and Wildlife Conservation Commission*

Mike Kirkland, *South Florida Water Management District*

Amanda Kissel, *U.S. Geological Survey*

Trevor Knight, *Florida Fish and Wildlife Conservation Commission*

Margaret Lamont, *U.S. Geological Survey*

Cooperators

Ted Lange, *Florida Fish and Wildlife Conservation Commission*

Marcus Lashley, *University of Florida*

Summer Lindelien, *Florida Fish and Wildlife Conservation Commission*

Ken Lohmann, *University of North Carolina, Chapel Hill*

Cully W. Lord, *City of Gainesville*

Kai Lorenzen, *University of Florida*

Andy LoShiavo, *U.S. Army Corps of Engineers*

Earl Lundy, *Florida Fish and Wildlife Conservation Commission*

James Lyons, *U.S. Geological Survey*

Michael Marshall, *Texas A&M University*

Julien Martin, *U.S. Geological Survey*

Jenna May, *U.S. Army Corps of Engineers*

Frank Mazzotti, *University of Florida*

Lisa McBride, *U.S. Geological Survey*

Gil McRae, *Florida Fish and Wildlife Conservation Commission*

Lourdes Mena, *U.S. Fish and Wildlife Service*

Matt Metcalf, *U.S. Geological Survey*

Debbie Miller, *University of Florida*

Melissa Miller, *University of Florida*

Karl Miller, *Florida Fish and Wildlife Conservation Commission*

Barron Moody, *Florida Fish and Wildlife Conservation Commission*

Clinton Moore, *U.S. Geological Survey*

Keith Morin, *Florida Department of Environmental Protection*

Eric Nagid, *Florida Fish and Wildlife Conservation Commission*

Melissa Nasuti, *U.S. Army Corps of Engineers*

Dan Nelson, *Florida Fish and Wildlife Conservation Commission*

Bryan Nuse, *University of Georgia*

Jason O'Connor, *Florida Fish and Wildlife Conservation Commission*

Bradley O'Hanlon, *Florida Fish and Wildlife Conservation Commission*

Madan Oli, *University of Florida*

Todd Osborne, *University of Florida*

Joyce Palmer, *U.S. Fish and Wildlife Service*

Geoff Parks, *City of Gainesville*

Kevin Patton, *Florida Department of Environmental Protection*

Ramesh Paudyal, *Florida Fish and Wildlife Conservation Commission*

Caroline Poli, *Florida Fish and Wildlife Conservation Commission*

Bill Pouder, *Florida Fish and Wildlife Conservation Commission*

Gregg Poulakis, *Florida Fish and Wildlife Conservation Commission*

Candice Prince, *University of Florida*

Raya Pruner, *Florida Fish and Wildlife Conservation Commission*

Erin Ragheb, *Florida Fish and Wildlife Conservation Commission*

Lindsey Reisinger, *University of Florida*

Steve Rider, *Alabama Department of Conservation and Natural Resources*

Erin Rivenbark, *U.S. Fish and Wildlife Service*

Ellen Robertson, *U.S. Geological Survey*

LeRoy Rodgers, *South Florida Management District*

J. Perran Ross, *University of Florida*

Mark Sandfoss, *U.S. Geological Survey*

Jesse Senko, *Arizona State University*

Donna Shaver, *National Park Service*

Colin Shea, *Florida Fish and Wildlife Conservation Commission*

Sarah Sherburne, *U.S. Geological Survey*

Katie Sieving, *University of Florida*

David Smith, *U.S. Geological Survey*

Sandra Sneckenberger, *U.S. Fish and Wildlife Service*

McKayla Spencer, *Florida Fish and Wildlife Conservation Commission*

Channing St. Aubin, *U.S. Fish and Wildlife Service*

Courtney Stachowiak, *Florida Fish and Wildlife Conservation Commission*

David Steen, *Florida Fish and Wildlife Conservation Commission*

Taylor Stein, *University of Florida*

Eric Suarez, *University of Florida*

John Sweka, *U.S. Fish and Wildlife Service*

Jessica Swindall, *Florida Coastal Conservancy*

Brandon Thompson, *Florida Fish and Wildlife Conservation Commission*

Melissa Tolbert, *City of West Palm Beach*

Jose Torres, *U.S. Geological Survey*

Robin Trindell, *Florida Fish and Wildlife Conservation Commission*

Nick Trippel, *Florida Fish and Wildlife Conservation Commission*

Paul Tritaik, *U.S. Fish and Wildlife Service*

Anna Tucker, *U.S. Geological Survey*

Quenton Tuckett, *University of Florida*

Travis Tuten, *Florida Fish and Wildlife Conservation Commission*

Hannah Vander Zanden, *University of Florida*

Maureen Walsh, *U.S. Fish and Wildlife Service*

Marsha Ward, *Florida Fish and Wildlife Conservation Commission*

Zach Welch, *South Florida Management District*

Brandon Welty, *University of Florida*

Stasey Whichel, *Florida Fish and Wildlife Conservation Commission*

Benjamin Wilkinson, *University of Florida*

Randy Wilson, *U.S. Fish and Wildlife Service*

Sam Wisely, *University of Florida*

Blair Witherington, *Inwater Research Group*

David Witmer, *City of West Palm Beach*

Chris Wynn, *Florida Fish and Wildlife Conservation*

Amy Yackel Adams, *U.S. Geological Survey*

Research Personnel

(Names in green are supervised by Powell, Carthy, McGowan, or Carlson)

University of Florida Cooperating Faculty

Miguel Acevedo, *WEC*
Robert Fletcher, *WEC*
Robert McCleery, *WEC*
Bill Pine, *WEC*
Christina Romagosa, *WEC*

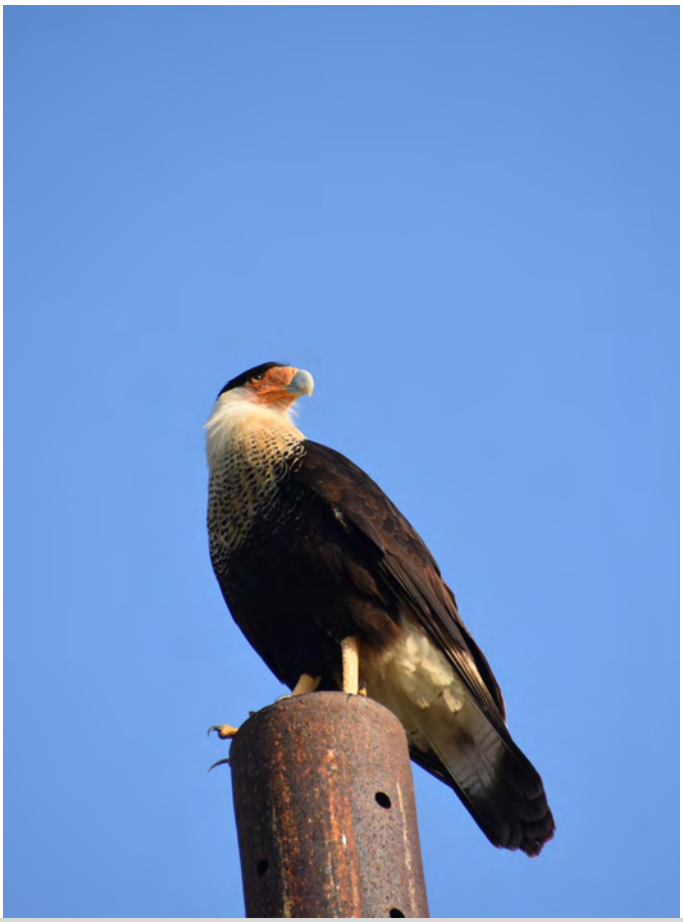
Support Staff

Ben Kahler, *Research Administrator*
Madison Heisey, *Administrative Assistant*
Cassidy Summerlin, *Research Administrator*
Jazmin Calderon, *Administrative Support Assistant*

Postdoctoral Research Scholars

Riley Andrade
Luke Evans
Adrian Figueroa
Ashley Goode
María Eugenia Iezzi
Marina McCampbell
Rebecca McKee
Stephen Parker
Ellen Pero

Crested Caracara. MADISON HEISEY



Graduate Students

Trenton Aguilar, *Ph.D., Fisheries and Aquatic Sciences*
ADVISOR: Raymond Carthy
*Graduated in 2024

Christopher Anderson, *Ph.D., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

Marion Baker, *M.S., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

Meghan Beatty, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Robert Fletcher

Kimberly Bonvechio, *Ph.D., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

Jazmyn Broxton, *M.S., Wildlife Ecology and Conservation*
ADVISOR: Raymond Carthy

Darcy Doran-Myers, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Conor McGowan

Lara Elmquist, *M.S., Wildlife Ecology and Conservation*
ADVISOR: Robert Fletcher

Kate Davis, *Ph.D., Zoology*
ADVISOR: Christina Romagosa and Hannah Vander Zanden

Chris Gulick, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Abby Powell

Jaiere Harlow, *Ph.D., Interdisciplinary Ecology*
ADVISOR: Raymond Carthy

Daniel Haro, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Christina Romagosa

Kodiak Hengstebeck, *Ph.D., Interdisciplinary Ecology*
ADVISOR: Christina Romagosa
*Graduated in 2024

Richard Herren, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Raymond Carthy

Brian Jeffrey, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Rob Fletcher

Diego Juárez-Sánchez, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Christina Romagosa

Shelby LeClare, *M.S., School of Natural Resources and Environment*
ADVISOR: Christina Romagosa
*Graduated in 2024

Research Personnel

(Names in green are supervised by
Powell, Carthy, McGowan, or Carlson)

Graduate Students (cont.)

Gabriela Logo, *M.S., Wildlife Ecology and Conservation*
ADVISOR: Christina Romagosa

Costanza Manes, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Raymond Carthy

Logan Masterson, *M.S., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

Kyle Miller, *M.S., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

Chelsea Myles-McBurney, *M.S., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

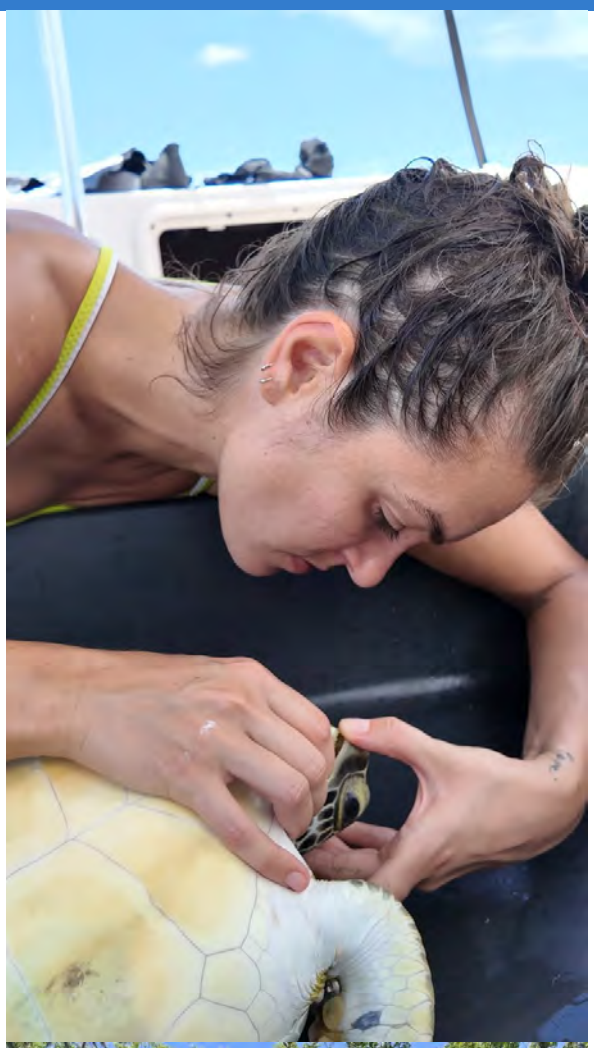
Rachel Smith, *Ph.D., Interdisciplinary Ecology*
ADVISOR: Raymond Carthy

Natalia Teryda, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Raymond Carthy

Andrew Wooley, *M.S., Fisheries and Aquatic Sciences*
ADVISOR: Andrew Carlson

Peter Xiong, *M.S., Wildlife Ecology and Conservation*
ADVISOR: Christina Romagosa

Ke Zhang, *Ph.D., Wildlife Ecology and Conservation*
ADVISOR: Abby Powell



Costanza Manes examining oral cavity of a juvenile green turtle for tumors. EVAN COOPER

Fall 2024 Coop Unit Potluck. UNKNOWN

Kyle Miller sampling Bluenose Shiner. UNKNOWN

Honors and Awards

Marion Baker, *M.S. student*. Student Scholarship Award top-3 finalist. Society of Lake Management Professionals. January 22, 2024.

Marion Baker, *M.S. student*. Noreen Clough Memorial Scholarship for Females in Fisheries. Southern Division, American Fisheries Society. May 28, 2024.

Kimberly Bonvechio, *Ph.D. student*. Best Lightning Talk. University of Florida, Fisheries and Aquatic Sciences Graduate Student Symposium. March 1, 2024.

Darcy Doran-Myers, *Ph.D. student.* Jennings Scholarship. 2024.

Darcy Doran-Myers, *Ph.D. student.* Outstanding Graduate Service to WEC award. 2024.

Kodiak Hengstebeck, *Ph.D. student*. African Safari Club Conservation Scholarship. 2024.

Lara Elmquist, *M.S. student*. Florida Ornithological Society Best Student Speaker Award. 2024.

Stephen Parker, *Postdoctoral researcher*. Southern Division American Fisheries Society Annual Meeting Best Student Presentation Nominee. 2024.

Darcy Doran-Myers: 2024 Jennings Scholarship and Outstanding Graduate Service to WEC award. ABBY POWELL

Alligator at Kissimmee Prairie Preserve State Park. MADISON HEISEY

Doris Duke Conservation Scholars Program

INVESTIGATORS		Christina Romagosa, Raymond Carthy, Rena Borkhataria (Doris Duke Charitable Foundation)
MENTORS:	Cohort 9:	Christopher Gulick (Ph.D., WEC), Jaren-Claude Serano (M.S., WEC), Rebecca McKee (Ph.D., WEC), and Eric Trotman (Ph.D., Zoology)
	Cohort 10:	Lara Elmquist (M.S., WEC), Lameace Hussain (Ph.D., WEC), and Peter Xiong (M.S., WEC)
DURATION		September 2013 - September 2024
FUNDING		Doris Duke Conservation Scholars Program Collaborative with University of Florida, USGS

The Doris Duke Conservation Scholars Program (DDCSP) Collaborative is a 2-year undergraduate conservation field program designed to provide students with an experiential introduction to a career in natural resources. The Arizona, Florida, Idaho, and Massachusetts Coop Units are members of the collaborative. The students attend leadership training, work with scientists and graduate students on research projects, and are mentored by current CRU program graduate students and Federal scientists. The Doris Duke Scholars participate in paid summer internships with local, State, Federal, and Tribal agencies, or nongovernmental organizations.

In 2024, Cohort 10 filled their second summer in the program with a range of career-building internships with various conservation agencies and organizations, and had the opportunity to attend The Wildlife Society's annual conference in October to present posters on their independent projects from their first summer.

The Doris Duke Conservation Scholars Program has been successful. Within five years of completing the program, more than two-thirds of our scholars are pursuing careers in environmental science and conservation. More than 25% of our scholars have completed or are pursuing graduate degrees related to conservation. The program is currently morphing into Conservation Collaborative Scholars Program (https://www.conservation-collaborative.org/) and will soon be launching with objectives that build on what we have achieved to date.

Jose Torres, Diana Rodas, Pablo Araya, Delana Gonzalez, Adam Nawrocki sampling Burmese Python. GENESIS APONTE SANTIAGO

Conservation Scholar Otto Alvarez records gas efflux measurements on a Panhandle beach. JAREN SERANO

Intern Cohorts:

Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)
Alex Cronin	Jeanette Brisbane	Modeline Celestin	Amy Almond	Keara Clancy
Nadia Kemal	Megan Ely	Camille DeJesus	Joelle Carbonell-Bierbaum	Faith Morgan
Jaclyn Selden	Charmaine Pedrozo	Hannah Innocent	Tre'nard Morgan	Kristina Rodriguez
Adreenah Wynn	Monica Quintiliani	Elizabeth Sherr	Marcela Mulholland	Desiree Smith
Xue "Jackie" Zhang	Sharmin Siddiqui		Camya Robinson	

Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Year 9 (2022)	Year 10 (2023)
Jacob Hornfeldt	Jazmyn Broxton	Maya Encinosa	Otto Alvarez	Pablo Araya
Gabriela Obando	Juliemar Cuevas-Hernandez	Maiya Lester	Jesus Rodriguez-Riverol	Delana Gonzalez
Eric Trotman	Aleidys Lopez Romero	Sebastian Summo	Logan Stratton	Emily Martucci
Herby Zephir	Mariaguadalupe Vilchez	Nimsi Trujillo	Spencer Zeitoune	Felix Roy

Research: Fisheries and Aquatic

Costanza Manes and Richard Herren release a loggerhead turtle. EVAN COOPER

Dead juvenile green turtle observed during field work, with injuries consistent with a vessel strike. TRENTON AGUILAR

Predicting future population impacts of vessel strikes on Green Turtle populations using empirical and modeling approaches

Vessel strikes pose a threat to sea turtles globally, with a particular impact in Florida where vessel strikes from commercial and recreational vessels has become the number one cause of stranding for sea turtles. To enhance our understanding and subsequently mitigate this peril, our research focuses on investigating the dynamics of vessel strikes involving turtles. This involves the examination of how such incidents occur, the prediction of high encounter zones between vessels and turtles, and an exploration of the potential influence of growing turtle and human populations on future mortality concerns. Conducting observational boat surveys, we measured turtle responses and flight initiation distances, comparing behaviors across different size classes of turtles, and determining green turtles of all size classes studied were equally susceptible to vessel strikes. This manuscript has been submitted and is being reviewed. Subsequently, we constructed an encounter rate model depicting the likelihood of interactions between green turtles and recreational boaters in Florida. This model highlights areas where these two groups may intersect, namely nesting beaches and human population centers. We also developed a population growth model to forecast the impact of growing human and green turtle populations in Florida on the escalating interactions with vessels. Our model illustrates the unsustainability of the current management surrounding vessel strikes on green turtles as interactions between boats and turtles increase alongside the human population growth in the state. The efficacy of the encounter rate model has been demonstrated in predicting zones of heightened turtle and boater interaction, with potential applications tailored to localized contexts where turtle density data is available. Furthermore, our population model elucidates various scenarios of vessel-related mortality and their potential effects on Florida's green turtle populations. As we accumulate more data, particularly on recreational boater registrations locally and across the state of Florida, as well as sea turtle species density, these models will evolve into valuable tools for future management planning.

INVESTIGATORS	Raymond Carthy, Trenton Aguilar, Mike Allen
STUDENT	Trenton Aguilar, Ph.D., FAS
DURATION	August 2018 - August 2024
FUNDING	NSF, Florida Education Fund, UF Graduate School, McKnight Doctoral Fellowship, Sea Turtle Conservancy
IN KIND SUPPORT	FAS

Identifying strategies for conservation of the marine turtles in Argentina and Uruguay, South America

Leatherback and green turtle populations have decreased exponentially across the world, leading to their current global protected status. Reasons for their decline include interactions with fisheries and habitat degradation. Information on habitat use, population densities, and threats is essential for their conservation. Due to their spatially heterogeneous life cycle, research and conservation efforts have relied on technological advances to gain understanding of their population and vulnerabilities in foraging areas like Argentina and Uruguay, in the Southwestern Atlantic Ocean. Efforts were directed to investigating the two endangered species with new technologies and the reinforcement of regional conservation and management networks. From November 2019 to March 2020 and December 2021 to May 2022, we conducted aerial surveys over the water both in along Santa Teresita and Punta Rasa coastal extension, located in the southern area of Samborombón Bay and the northern area of Cabo San Antonio (Buenos Aires province, Argentina) and Rio de La Plata in the Cerro Verde and Islas de La Coronilla Marine Protected Area (CMPA) (department of Rocha, Uruguay). We deployed the UAS collecting video of the coastal foraging grounds while flying automatized linear transects at an altitude of 35 - 40 m. In Argentina, we collected 2.13 hours of video from leatherback surveys and a total of 20.4 hours of video from green turtle surveys in Uruguay. After reviewing the videos, we counted 99 leatherback turtles and 1085 green turtles. The resulting Observations-per-Unit-Effort were 20.4 and 53.18 leatherback and green turtle per hour respectively. For determining relative density, we conducted the calculations both with and without a correction factor for the probability of turtles being visible, g(0) for both species. This probability was calculated using diving behavior telemetry and UAS for leatherback turtles while the probability for green turtles is currently being processed using radio transmitter and UAS data. The traditional density estimate for leatherback turtles was 3.08 turtles per 100 km2 while for green turtles was 1.54 turtles per km². In contrast, after accounting for the probability of turtles being visible (g(0) = 0.3183) in the leatherback relative density estimates, the results indicated 10.2 turtles per 100 km². Our work indicates that UAS are effective tools for sea turtle monitoring in a region that was previously understudied due to environmental factors like water clarity. Furthermore, we show the potential benefit of using UAS in sub-optimal environmental and oceanographic conditions, providing information and opportunities to study habitat use, distribution and density of these two sea turtle species in the Southwestern Atlantic.

INVESTIGATOR	Raymond Carthy
STUDENT	Natalia Teryda, Ph.D., WEC
DURATION	August 2019 - May 2025
FUNDING	FL CoOp Unit, SNRE, KARUMBE

Aerial view captured by DJI Phantom 4 Pro V2 of Cerro Verde, CV-CMPA, Uruguay. NATALIE TERYDA

Richard Herren releasing a juvenile green turtle in April 2024. EVAN COOPER

Sea turtle abundance, demographics, and movements in the northeastern Gulf of Mexico

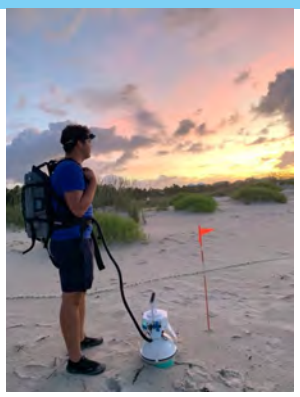
Conservation efforts since the 1970's have led to increases in some sea turtle populations and decreases or no change in others. However, in general, there is lack of biological knowledge to inform recovery plans, particularly for in-water life stages. This research is part of a collaboration between Sea Turtle Conservancy and Dr. Carthy at the USGS Florida Cooperative Fish and Wildlife Research Unit. The objective is to understand the abundance, demographics, movements, and threats in Florida's Big Bend and Panhandle regions. In the first study completed in 2018 and 2019, we used boat -based surveys to estimate abundance in the Big Bend using distance sampling and probability of detection models. The surveys indicated that green turtles were the most abundant species in the Big Bend with the south sub-region containing the most turtles (Citrus and Hernando counties). In the second study from 2019-2023, we compared size, sex ratio, and genetic origin between three widely separated juvenile green turtle aggregations. We found significant differences in size, habitat, and sex ratio between the aggregations. In 2019-2021, we tracked green turtle overwintering movements using satellite telemetry and correlated movements with water temperature and water depth. The turtles made short and medium-range migrations during the winter and returned to their original capture site in the spring. These three studies are currently being written up for publication. Additional research has been underway since 2022, including a collaboration with Ph.D. candidate Costanza Manes on the etiology of the tumor-bearing disease fibropapillomatosis, a study on green turtle health in collaboration with the Florida Aquarium and Bermuda Zoological Society, and a study tracking overwintering movements in endangered Kemp's ridleys.

INVESTIGATOR Raymond Carthy

STUDENT Richard Herren, Ph.D., WEC

DURATION September 2019 - December 2025

FUNDING Sea Turtle Conservancy



Doris Duke Conservation Program Scholar Otto Alvarez taking gas efflux measurements at Salinas Beach, Cape San Blas, FL. JAREN-CLAUDE

Tidally-driven gas exchange: Effects on loggerhead sea turtle (*Caretta caretta*) hatchling emergence

Florida's coastline is constantly reworked by long and short-term climatic cycles. Shifts in the frequency and intensity of those cycles due to global change, in conjunction with anthropogenic alterations, are affecting the resilience of coastal habitats and the species that rely on them. This research is integrating existing approaches with novel techniques to examine the coupling of oceanographic and onshore processes and their effects on sea turtle nest incubation and dune stabilization. Sea turtles nest in a variety of beach environments, and the success of an individual nest is influenced by its location on the beach and the resulting incubation micro-environment. Some of the factors affecting sea turtle nest incubation include moisture, rainfall, sand particle size, temperature, tides, and gas exchange. We are evaluating how beach incubation dynamics and productivity respond to altered gaseous environments. The objectives of this study included investigating how gas exchange on beaches fluctuates throughout the tidal cycle on different beach types by using CO-2 efflux as a proxy to quantify this exchange. Findings were compared with the most recent hatchling emergence success data from the beaches observed, to deduce the effects these factors may have on hatchling emergence success over time. The effects of the tidal cycle on gas efflux readings in the study system were examined using an infrared trace gas analyzer. Sand samples from each beach were collected and then processed using a graduated series of U.S standard sieves. Results revealed that higher emergence success occurred at the beach possessing the finer sand particle size and a higher, more stable CO2 efflux. However, due to additional variables involved in incubation and successful emergence, further investigation is required to better comprehend the relationship between emergence success and tidally driven gas exchange. Results from this work can identify habitat suitability issues and inform conservation planning measures and better nourishment practices, including mitigation and alternative actions.

INVESTIGATOR Raymond Carthy

DURATION September 2020 - May 2026

FUNDING USGS (RWO 316)

Costanza Manes collects data on a loggerhead turtle. EVAN COOPER

Integrative assessment of Fibropapillomatosis dynamics in free-roaming Green Turtles (*Chelonia mydas*) from the northeastern Florida Gulf

Fibropapillomatosis (FP) is a neoplastic epizootic of sea turtles. Green turtles (*Chelonia mydas*) are the most heavily affected species, with high prevalence in Florida. This debilitating disease forms tumors on the turtle bodies, preventing them from seeing, swimming, and feeding properly. FP incidence is increasing, and its threat to the conservation of green turtle populations needs to be better understood. Because of the unknown factors in the etiology of this disease, we must look at viral (herpesvirus ChHV5 associated with FP) and host factors, as well as environmental factors that might exacerbate severity and spread of the disease in wild green turtle populations. Objectives are to determine prevalence and severity of FP, quantify the load of two viruses associated with the disease (Chelonid Herpesvirus 5 and *Chelonia mydas* papillomavirus 1) and distribution of carcinogenic pollution in the study sites. The goal is to find correlation between host, virus, and environmental factors to unfold disease etiology. Sea turtles are sampled for morphometric measurements. Viral load is quantified from tissues in the lab via quantitative polymerase chain reaction (qPCR). Pollution is measured in the ocean study site via deployment of Semipermeable membrane Devices (SPMDs), processed and analyzed in a toxicology specialized laboratory. FP prevalence in study site sea turtle populations is about ~70%. Viral load seems to be dictated by factors inherent to the host size and environment (seawater hypoxia). Disease severity significantly impacts host body condition; disease hosts are further affected by a combination of barnacle (epibionts) coverage and potential of mechanical damage. Our results have enriched our understanding of FP burden in local sea turtle populations. Our carcinogenic pollution findings can aid policies in targeting pollution sources and applying the appropriate measures to limit pollutant release in coastal seawater.

INVESTIGATOR Raymond Carthy

STUDENT Costanza Manes, Ph.D., WEC

DURATION January 2021 - May 2025

FUNDING One Health Center of Excellence, National Save the Sea Turtle Foundation

Manatees at Crystal River National Wildlife Refuge. JAIERE HARLOW

A Coupled Human and Natural Systems (CHANS) framework for analysis of current manatee research and conservation efforts in Florida

The Florida manatee (*Trichechus manatus latirostris*) has become prioritized for scientific research due to its conservation status. Manatees were downlisted from endangered to threatened in 2017 after meeting the downlisting criteria established in the 2001 Florida Manatee Recovery Plan (Marine Mammal Commission, 2022). Although population numbers have been steadily increasing in certain areas, there have been environmental setbacks exposing pre-existing ecological conditions, now thought to be contributors to recent mortality events. Dietary shifts in Florida manatees have prompted scientists to reassess their health, foraging behavior, and the relationship between their seasonal movements and environmental changes caused by human activities. Despite ongoing conservation efforts, concerns remain about the future of the Florida manatee population, particularly regarding habitat management and human impacts across the state. Furthermore, there has been limited integration of socioeconomic factors and the interplay between natural and human systems in current research. The objective of this study is to apply a Coupled Human and Natural Systems (CHANS) framework to examine how ecological and human factors affecting Florida manatees influence the broader social-ecological system. It aims to deepen understanding of the connections, feedbacks, and impacts within this system, particularly regarding professional and public knowledge of current manatee conservation challenges in Central Florida. Structured surveys were administered at public events in Crystal River, Florida, an area historically known for manatee aggregations during the winter months. Surveys were also distributed online via Qualtrics to professionals in wildlife conservation or related study areas. Research objectives include identifying knowledge gaps and misconceptions that the public has about manatee conservation, to help improve conservation efforts for increased support of current and future manatee populations. Our findings will be placed into a historical perspective to inform management agencies for continued protection and sustainability of the manatee population in Florida.

INVESTIGATORS	Raymond Carthy
STUDENT	Jaiere Harlow, Ph.D., SNRE
DURATION	January 2023 - December 2027
FUNDING	USGS (RWO 330), USFWS

Lessons from a long-term fisheries monitoring program: The Florida experience

In 2006, the Florida Fish and Wildlife Conservation Commission (FWC) implemented a Freshwater Fisheries Long-term Monitoring (LTM) Program to assess temporal trends in freshwater fish population distribution and community structure in 29 lakes and reservoirs across the state. However, the LTM Program has yet to be comprehensively evaluated, and implications of such an evaluation for fisheries management are unknown. Evaluating the LTM Program through consideration of multiple perspectives and tradeoffs (e.g., ecological, statistical, resource availability) will help guide fisheries management decision-making in Florida's freshwater ecosystems. Our objectives are to assess temporal trends in fish population distribution and community structure in 29 Florida lakes and reservoirs since 2006, determine the efficacy of various fish sampling protocols for achieving LTM Program objectives, and develop recommendations for LTM Program delivery and associated fisheries management efforts in Florida. We will evaluate trends in fish population and community metrics within and across lakes over 15 years. We will also identify optimal combinations of sampling gears, locations, and sample sizes for achieving LTM Program objectives and develop recommendations for maximizing the efficiency and continued effectiveness of the program. Our analyses and statistical modeling will yield insights for understanding drivers of fish population distribution and community structure across Florida, as well as potential shifts in these parameters amid natural and anthropogenic changes (e.g., hurricanes, large-scale habitat manipulations). This project will allow fisheries managers to track the success of the LTM Program in achieving its objectives, identify areas for improvement, and showcase the relevance of the program for fisheries management, conservation, and public engagement.

INVESTIGATOR	Andrew Carlson
STUDENT	Kimberly Bonvechio, Ph.D., FAS
DURATION	July 2021 - June 2026
FUNDING	FWC, USGS (RWO 321)
IN KIND SUPPORT	FWC

Kimberly Bonvechio, Ph.D. student. FWC

Chris Anderson, Ph.D. student. FWC

Leveraging habitat suitability modeling to inform management of nonnative fishes in a changing climate

Florida contains more than 200 nonnative fishes that cause major ecological and societal consequences. Florida faces diverse challenges in nonnative fish management—challenges that may be exacerbated by climate change and associated effects on water temperature, a "master variable" affecting the bioenergetics of individual fish and the dynamics of fish populations and communities. As such, there is a need to understand water temperature variability (e.g., daily, seasonal, annual) and the effects of climate change on aquatic thermal regimes to inform nonnative fish management in Florida. Our objective is to predict survival, reproduction, recruitment, and dispersal of priority nonnative fishes in Florida over the next 50 years to develop science-driven approaches for managing these species. We will also experimentally evaluate the effects of Tilapia *Oreochromis* spp. on population dynamics of Largemouth Bass and Bluegill. We will supplement an existing network of 300 water temperature loggers distributed across Florida by deploying 75 additional loggers in key rivers and canals that are not currently monitored. Water temperature monitoring and climate change forecasting will allow us to develop models to predict nonnative fish survival, reproduction, recruitment, and dispersal based on multiple potential climatic scenarios in 2021–2070. Experimental work will occur collaboratively with USGS-WARC. Our analysis will yield life-stage-specific information about the thermal habitat suitability of Florida rivers and canals for nonnative fish in 2021–2070. Our research will generate predictive distribution maps, decision support tools, and stakeholder engagement activities to help manage nonnative fishes and inform the public about fisheries conservation. This project will allow fisheries managers to develop robust, spatially explicit programs for preventing the introduction, slowing the spread, eradicating, and controlling nonnative fishes in Florida.

INVESTIGATOR	Andrew Carlson
STUDENTS	Chris Anderson, Ph.D., FAS Lexie Scott, Undergraduate Honors Thesis
DURATION	July 2021 - June 2026
FUNDING	FWC, USFWS, USGS-WARC (RWO 327)
IN KIND SUPPORT	FWC, USGS-WARC

Logan Masterson, M.S. student. FWC

Investigating Grass Carp movement, habitat use, emigration, and natural mortality after stocking in the Harris Chain of Lakes, Florida

Water quality has improved in Florida's Harris Chain of Lakes over the last two decades, creating favorable conditions for expansion of hydrilla, an invasive plant. Herbicide treatments of hydrilla are controversial and expensive, with treatments in the Harris Chain of Lakes accounting for up to 25% of the statewide budget of the FWC Invasive Plant Management section. Given the cost and controversy associated with herbicide application, there is a need to explore alternative control techniques to reduce reliance on chemical treatments. Grass Carp are herbivorous fish that can be efficient, cost-effective consumers of hydrilla, but research on Grass Carp movement and habitat use is needed to identify appropriate stocking rates for the Harris Chain of Lakes. Our objectives are to evaluate stocking mortality and first-year survival of juvenile triploid Grass Carp stocked into lakes Apopka and Yale; assess Grass Carp movement, habitat use, and emigration rates; and investigate mortality and emigration of adult Grass Carp translocated into Lake Apopka. We will use radio telemetry to evaluate Grass Carp movement, habitat use, emigration, and natural mortality. We will use telemetry data to build population models and identify stocking rates that balance the need to reduce herbicide treatment while minimizing consumption of native vegetation by Grass Carp. Our research will provide management-relevant information about the utility of Grass Carp for controlling hydrilla in the Harris Chain of Lakes. Data on Grass Carp movement, habitat use, emigration, and natural mortality will inform population modeling to determine appropriate Grass Carp stocking rates. Hydrilla management is a costly, controversial topic in Florida. Our research on Grass Carp population characteristics and stocking rates will provide important information for integrating herbicide treatments with cost-effective biological control options.

INVESTIGATOR	Andrew Carlson
STUDENT	Logan Masterson, M.S., FAS
DURATION	October 2021 - June 2024
FUNDING	FWC
IN KIND SUPPORT	FWC

Clockwise from top left: Andrew Carlson, Bethany Gaffey, Katrina Rossos, Josh Vine. TYLER STEVEN COLEMAN

Abiotic and biotic factors affecting fish occurrence, abundance, and growth in sixty Florida lakes

Studying the effects of abiotic and biotic factors on fish populations is a long-standing tradition in fisheries science. However, there is less information on how fish populations and communities respond to abiotic and biotic factors across broad spatial extents, diverse lake types, and associated gradients in lake surface area, trophic state, and aquatic macrophyte coverage, particularly in Florida. There is a need to evaluate how environmental factors varying across large regions affect fish populations, fish communities, and fisheries management. Addressing these knowledge gaps could reveal useful information for managing fish populations and communities in regions with wide-ranging environmental conditions, and predicting how fish populations and communities may respond to environmental changes (e.g., land-use alteration, eutrophication, water diversion). The objective of this study is to investigate fish population and community characteristics in relation to abiotic and biotic factors across wide-ranging conditions of lake surface area, trophic state, and macrophyte abundance in Florida. We will use univariate and multivariate statistical approaches and population models to evaluate relationships between fish population and community metrics and abiotic and biotic factors in Florida lakes. We will integrate these analyses with existing management information to make recommendations for fisheries management now and in the future, in the context of expected environmental changes. Our research will generate data summaries and statistical models to quantify and predict fish occurrence, abundance, growth, and related population/community characteristics in Florida lakes. As environmental changes affect fish populations across Florida and the world, there is a need to understand and predict how fisheries are affected by wide-ranging abiotic and biotic factors in diverse water bodies. Our research will help fill these knowledge gaps and yield practical information for fisheries management in Florida.

INVESTIGATORS	Andrew Carlson, Mark Hoyer
DURATION	October 2021 - June 2026
FUNDING	UF LAKEWATCH Program, FWC
IN KIND SUPPORT	UF LAKEWATCH Program, FWC

Andrew Wooley, M.S. student. FWC

Ecology and conservation of endangered Smalltooth Sawfish

The Smalltooth Sawfish is a Federally endangered species that is confined to a small portion of Florida's coast. Despite active research on Smalltooth Sawfish by multiple organizations across Florida, key knowledge gaps remain. More information is needed on Smalltooth Sawfish habitat use and movement in Charlotte Harbor—an area that contains critical habitats for the species across its life history—to inform management and conservation programs. Our objectives are to (1) identify ontogenetic shifts in habitat use of Smalltooth Sawfish in Charlotte Harbor and (2) evaluate residency of juvenile fish by quantifying patterns in habitat use and home range as related to sex, size, and environmental factors. We will use acoustic telemetry and catch data to assess the duration and timing of Smalltooth Sawfish habitat use in Charlotte Harbor, with emphasis on nursery, refuge, and foraging areas and other high-priority locations. We will give special emphasis to characterizing ontogenetic habitat shifts at size classes that have historically been most difficult to monitor (i.e., intermediate-sized fish and the very largest individuals). Our analyses and statistical modeling will yield insights for understanding what habitats are most important for Smalltooth Sawfish across their life history in Charlotte Harbor. We will also characterize when and why shifts in habitat use occur. This project will provide fisheries managers with key information on Smalltooth Sawfish habitat use and movement that will allow them to prioritize habitats and management strategies to promote conservation of this endangered species.

INVESTIGATOR Andrew Carlson

STUDENT Andrew Wooley, M.S., FAS

DURATION July 2022 - December 2024

FUNDING FWC, NOAA

IN KIND SUPPORT FWC

Kyle Miller, M.S. student. FWC

Evaluating a habitat suitability index for Bluenose Shiner populations in peninsular and panhandle Florida rivers

The Bluenose Shiner is a threatened species in the state of Florida that is vulnerable to water quality degradation and habitat loss. Despite the imperiled status of Bluenose Shiner and imminent conservation threats, the species has received relatively little research attention. Bluenose Shiners have a spatially disjointed range in Florida, with populations concentrated in rivers of the north-central peninsula and western panhandle and no documented populations elsewhere. Researchers recently developed a Habitat Suitability Index (HSI) for Bluenose Shiners based on expert opinion, but the HSI has not been empirically validated. The objectives of this project are to (1) develop range-wide water velocity, water depth, and cover/substrate HSIs for Bluenose Shiners in Florida; (2) provide updated information on the spatial distribution of Bluenose Shiners in Florida; and (3) identify key Bluenose Shiner habitats for protection and rehabilitation. Our research will combine fish sampling in rivers where Bluenose Shiners have been previously documented (e.g., Alexander Springs Creek, Rock Springs Run, portions of the Escambia and Yellow rivers) with GIS analysis and HSI modeling. Our research will provide updated information on Bluenose Shiner distribution in Florida and yield new insights into how environmental conditions influence Bluenose Shiner population demographics. This project will provide aquatic resource managers with important information for conserving Bluenose Shiner populations and their habitats while informing establishment of statutory minimum flows and levels (MFLs) for key water bodies.

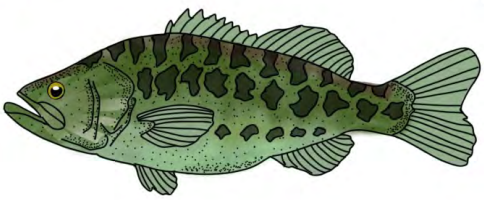
INVESTIGATOR Andrew Carlson

STUDENT Kyle Miller, M.S., FAS

DURATION July 2022 - December 2024

FUNDING FWC

IN KIND SUPPORT FWC



Largemouth Bass. MARIAGUADALUPE VILCHEZ

Marion Baker, MFAS student. GEORGIA DNR

Effects of Spotted Bass on Shoal Bass and Largemouth Bass in the Flint River

Shoal Bass are endemic to the Apalachicola–Chattahoochee–Flint (ACF) River basin in Florida, Georgia, and Alabama and support a socioeconomically important fishery. Introduction of nonnative Spotted Bass into the ACF basin is cause for concern due to potential negative interactions with Shoal Bass and Largemouth Bass. The Georgia DNR maintains robust, long-term data on population demographics of Shoal Bass, Largemouth Bass, and Spotted Bass in the Flint River, information that has yet to be comprehensively analyzed. We are forming a tri-state collaboration (Florida, Georgia, Alabama) to assess how Shoal Bass and Largemouth Bass have responded to the introduction of Spotted Bass in the Flint River. We will also evaluate how quickly Spotted Bass have spread throughout the system and identify how environmental conditions influence their establishment and population demographics. We will supplement a long-term database on population demographics of Shoal Bass, Largemouth Bass, and Spotted Bass in the Flint River with contemporary field sampling and statistical modeling. Our analyses will reveal if and how Shoal Bass and Largemouth Bass been affected by the introduction of Spotted Bass in the Flint River. This project will provide new insights for managing native bass species and associated fisheries in the ACF basin.

INVESTIGATOR Andrew Carlson

STUDENT Marion Baker, M.S., FAS

DURATION November 2022 - December 2025

FUNDING Georgia DNR

IN KIND SUPPORT Georgia DNR

Chelsea Myles-McBurney, M.S. student. UNKNOWN

Understanding and conserving gravel-bar fish assemblages in the Escambia River, Florida

Gravel bars are dynamic riverine habitats important for the life-history processes of aquatic and terrestrial species. Relatively uncommon in the subtropical and temperate rivers of Florida, gravel bars are important, data-limited systems in need of more research in the Sunshine State. There is a need to identify the abiotic and biotic factors that influence gravel-obligate fish species and gravel-bar fish assemblages in Florida rivers. Likewise, there is a need to evaluate how these abiotic and biotic factors, and their effects on gravel-bar fish assemblages, change over space and time. The objectives of this project are to (1) evaluate fish assemblages in gravel bars within the Escambia River, with a special focus on fish Species of Greatest Conservation Need; and (2) assess the degree to which observed changes in gravel-bar fish assemblages are related to time of day, depth, season, and environmental factors. We will integrate FWC fisheries data with a series of univariate and multivariate statistical approaches and population models to evaluate the status of gravel-bar fish assemblages in the Escambia River in the context of environmental change. Our study will produce data summaries and statistical models to quantify and predict how abiotic and biotic factors influence gravel-obligate fish, including Species of Greatest Conservation Need, in the Escambia River. Gravel bars are home to Species of Greatest Conservation Need in Florida, yet they are relatively understudied systems, particularly from a fisheries perspective. Our research will yield novel information about the current and projected future status of gravel-bar fish assemblages in the Escambia River that will aid fish conservation efforts in north Florida and other areas with gravel-bar habitats.

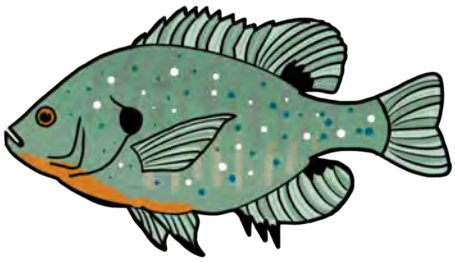
INVESTIGATOR Andrew Carlson

STUDENT Chelsea Myles-McBurney, M.S., FAS

DURATION May 2023 - December 2025

FUNDING FWC

IN KIND SUPPORT FWC



Bluegill. MARIAGUADALUPE VILCHEZ

Assessing effects of Tilapia *Oreochromis* spp. on Largemouth Bass *Micropterus salmoides* and Bluegill *Lepomis macrochirus* reproduction, recruitment, and growth

Evaluating the effects of non-native freshwater fishes on native species in Florida is important for fisheries management. However, quantitative research of this kind is often lacking. Efforts to assess the effects of non-native fishes on native species will help guide fisheries management decision-making in Florida's freshwater ecosystems. Our objective is to conduct a pond study to evaluate the effects of one of the most widespread genera of non-native freshwater fish, Tilapia Oreochromis spp., on two ecologically and socioeconomically important native fishes, Florida Bass *Micropterus salmoides* and Bluegill *Lepomis macrochirus*. We will build on previous research by assessing the effects of both low- and high-density Tilapia populations on age-0 and age-1 Florida Bass and Bluegill reproduction, recruitment, and growth in nine 0.4-ha ponds. The study site (USGS Wetland and Aquatic Research Center) is located near the current latitudinal limit of established Tilapia populations in Florida. Our analyses and statistical modeling will yield insights for understanding how Tilapia affect reproduction, recruitment, and growth of Florida Bass and Bluegills. Evaluating how Tilapia influence reproduction, recruitment, and growth of Florida Bass and Bluegill will provide managers with information that could be used to identify water bodies where ecological effects of Tilapia are most likely. Moreover, assessing the influence of environmental parameters will provide managers with knowledge as to how the ecological effects of Tilapia could change in response to changing environmental conditions in freshwater ecosystems.

INVESTIGATORS Chris Anderson, Andrew Carlson

STUDENT Chris Anderson, Ph.D., FAS

DURATION July 2023 - June 2026

FUNDING FWC, USGS

IN KIND SUPPORT FWC, USGS

Bethany Gaffey and a Gulf Sturgeon. TYLER STEVEN COLEMAN

Informing Gulf Sturgeon population status and trends as a baseline to measure PDARP actions to promote species recovery

A long-term goal of the Gulf Sturgeon Recovery Plan is to establish self-sustaining populations that could allow the delisting of the species. However, population status and trends are uncertain. Additionally, the effects of new and changing threats on population viability is unknown. Despite the differing objectives of previous short-term, small-scale studies, most employed mark-recapture techniques, which can be used as a common analytical framework for analyses. Most studies focused on adult fish, so we collected new juvenile data. We aimed to gain insight into the status and trends of Gulf Sturgeon population dynamics across their range by utilizing all available adult Gulf Sturgeon data within a common analytical framework to estimate population parameters and inform population viability simulations. We also set out to learn more about juvenile occupancy and mortality patterns. We synthesized available Gulf Sturgeon data in a common database and used it to generate capture histories for mark-recapture models to estimate survival, movement, and recruitment. We used these estimates to inform simulations of future population conditions. We also telemetered fish to understand juvenile occupancy and mortality patterns in the Choctawhatchee River. Our analyses suggest that adult Gulf Sturgeon survival is generally high, but lower survival rates in the western Gulf may limit population recovery. Extirpation risk among these populations also differs as lower adult survival rates and initial abundances make these western Gulf populations more susceptible to episodic mortality events. Juvenile analyses support adaptation potential in the context of future environmental conditions as these fish demonstrated avoidance of unfavorable conditions. We evaluated future threat scenarios and determined there is little risk of losing all seven river populations. If there is interest in promoting resilience through maintaining all populations, then actions should be taken to ensure populations are at, or above, the critical levels of abundance and survival identified in this project. Reassessing critical habitat in terms of providing capacity for adaptation is an area of crucial future work.

INVESTIGATORS Bill Pine, Andrew Carlson

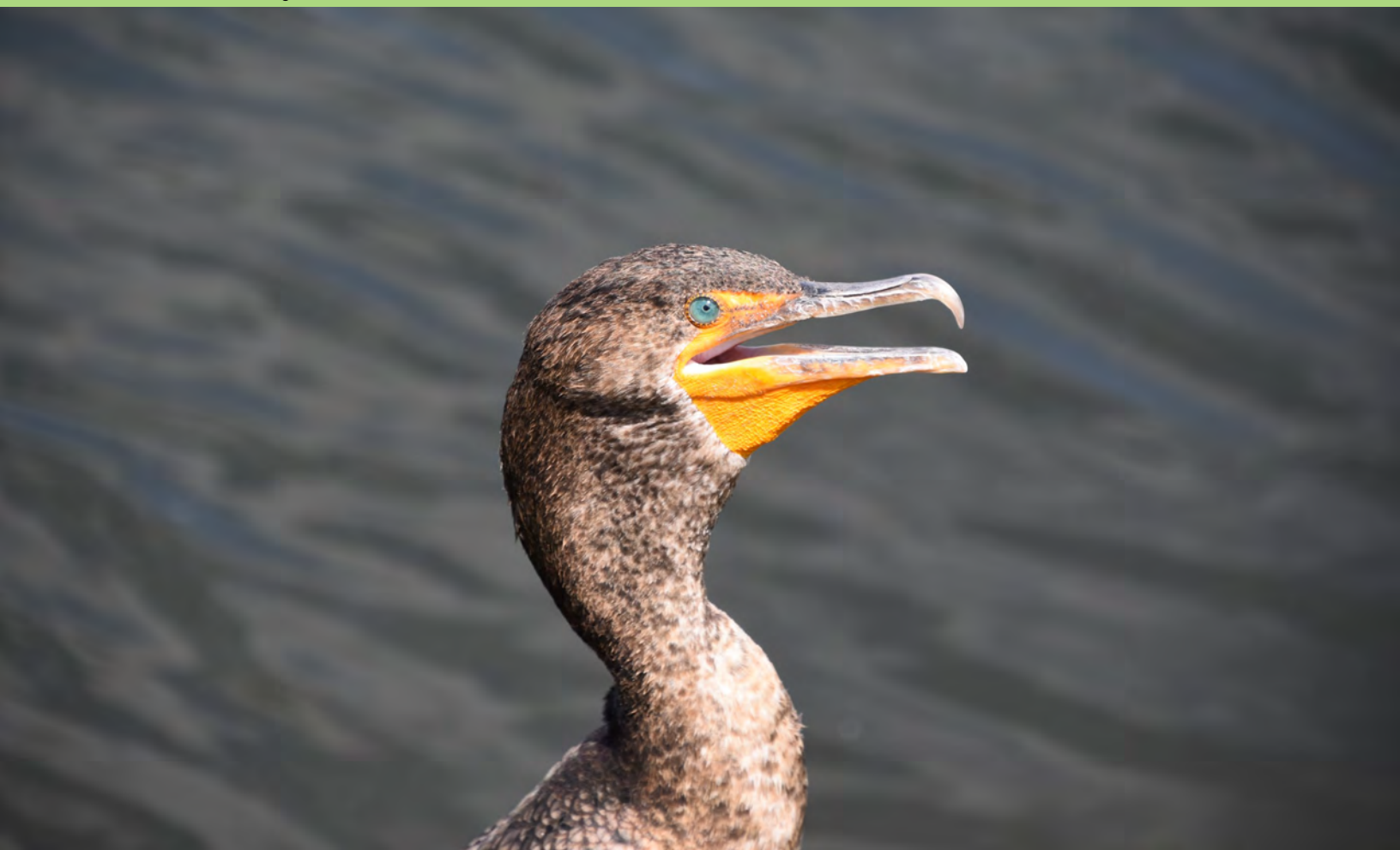
POST-DOC Stephen Parker, WEC

DURATION July 2019 - December 2024

FUNDING NOAA, USFWS (RWOs 308 and 313)

Research: Wildlife and Habitats

Cormorant in Everglades National Park. MADISON HEISEY



Juvenile red knot with satellite transmitter at Fort DeSoto, Florida. PETER PLAGE

Movements and overwinter survival of juvenile Red Knots (*Calidris canutus rufa*) in Southeast US: Information needs for recovery planning

Research and conservation on Red Knots over the past twenty years has focused on adult birds using only a few sites, primarily in the mid-Atlantic region. However, by focusing on just one stage in their annual cycle there is a chance that factors that are driving Red Knot populations are being missed. We need to better understand the juvenile life stage to ensure that conservation actions to recover the species are appropriately directed to the areas that have the most significant impact on population growth. We aimed to identify the main area(s) in the Southeast US and Caribbean where juvenile Red Knots occur during their first two years of life, determine how long they survive, and whether they recruit into the adult population. Field work was delayed for two years due to covid-19, but we captured, banded, and flagged 24 juvenile red knots in 2022 and 23 juveniles in 2024 at Fort DeSoto, Florida. Of the 2022 cohort, 75% of the birds have been resighted at least once as adults, including at Delaware Bay, Seabrook Island, South Carolina, the Florida Panhandle, and Tampa Bay. Most (91%) of the 2024 cohort have been resighted at least once. We also deployed solar-powered satellite transmitters on juveniles at Fort DeSoto in March 2024. These birds remained around Tampa Bay through mid-May but then began movements out of the area to the Florida Panhandle and south to Cape Coral. The timing of these movements corresponded with when the adult birds left Tampa Bay to travel north to the breeding grounds. The satellite transmitters only provided data through the summer months, where these birds remained residents in Florida. Resighting data from banded birds and eBird, along with the location data from satellite transmitters, show the importance of sites within Florida and South Carolina during the summer months for first- and second-year knots. The presence of protected areas in close proximity to good foraging habitat, such as at Fort DeSoto, is critical for all age classes of knots.

INVESTIGATORS	Abby Powell, Jim Lyons, Kevin Kalasz
DURATION	August 2019 - December 2025
FUNDING	USGS (RWO 309)
IN KIND SUPPORT	USFWS

Colonial nesting wading bird tracking and habitat use assessment

Key information is missing from populations of coastal-dwelling wading birds that may have been damaged by the Deepwater Horizon oil spill in the northern Gulf of Mexico. To better conserve these populations, we need to understand their movement ecology to guide future restoration efforts. Our objectives were to determine dispersal patterns and seasonal movements of white ibises and tricolored herons that breed in nesting colonies in coastal Alabama, as well as the health and survival of each species. We deployed transmitters on 50 white ibis and 49 tricolored herons over three breeding seasons, 2020-2022. Preliminary analyses indicate that both species show a pattern of partial migration, with a proportion of birds remaining in coastal Alabama following the breeding season as residents. However, migratory white ibises moved both west and east from Alabama and established more home ranges and exhibited lower philopatry than tricolored herons during the non-breeding season. Migratory tricolored herons either crossed the Gulf from Alabama or first moved west to Louisiana before crossing the Gulf during fall migration. These herons staged in the northern Yucatan Peninsula of Mexico and either remained there or moved farther south to Honduras and Nicaragua. Tricolored herons also staged in the northern Yucatan and Louisiana during spring migration, emphasizing the importance of these wetland areas in the USA and Mexico for this species. White ibis on the other hand moved widely across the southern USA using a variety of habitats; coastal wetlands and the Atchafalaya Basin in Louisiana were both important areas for white ibis. Although some white ibis moved east into Florida, we did not find evidence of birds moving to the Atlantic Coast. One ibis overwintered in Cuba. We found differing levels of natal and breeding site fidelity to the colonies in coastal Alabama for both species, but less evidence of wintering site fidelity. Our research will be useful to managers as they develop conservation plans, preserve critical habitats, and assess each species' ability to respond to environmental disasters like catastrophic oil spills.

INVESTIGATOR	Abby Powell
STUDENTS	Ke Zhang, Ph.D., WEC Chris Gulick, Ph.D., WEC
DURATION	September 2019 - December 2025
FUNDING	USGS (RWO 307)

White ibis with satellite transmitter relighted near New Orleans, Louisiana. ATLEE HARGIS

Controlled burn underway in sandhills. ANDREW ORTEGA

Elicitation. CONOR MCGOWAN

Workshop. CONOR MCGOWAN

Building rural wildfire resilience through GIS mapping and UAV verification of High-Risk-Lightning strikes

Lightning ignitions are responsible for over 70% of the area burned in the American West, totaling 5.5 million acres of land burned annually. These major wildfires significantly impact vulnerable communities causing between $120 to $190bn of economic damages each year. Currently, it can take 24 hours or more to find lightning-ignited wildfires by which time they are often burning out of control. Quick and reliable detection and verification of such wildfires are especially critical for the safety and security of vulnerable remote and rural communities. Fire Neural Network (FNN) has developed proprietary technology that can identify the small number of lightning strikes likely to cause a wildfire. The next important step is to quickly and accurately verify these likely lightning-ignition spots. This will strengthen rural community resilience by reducing fire verification times from 24 hours to 20 minutes and it will empower community leaders with situational awareness on lightning-initiated wildfires, along with the assessed vulnerabilities within the local community. We assessed several drone flight path planning search patterns, to optimize response speed and accuracy for precise location of possible lightning -ignitions triggered by the FNN instruments operated by FNN at Florida Forest Service (FFS) locations. UF has a long history of UAS development and operation in the natural settings of Florida and we have developed flight planning to maximize aerial coverage for survey, mapping, and wildlife population estimates for species such as wading/nesting birds and manatees. For the identification of a fire source located within a set distance of a predicted location, this flight pattern may not be the most efficient (optimal) in identifying the location in the shortest amount of time, but it can completely and reliably cover the entire area prescribed with redundancy, due to overlapping imagery. The study results are being used to implement fire search algorithms for FNN's Fire XPrize initiative.

INVESTIGATOR Raymond Carthy, Peter Ifju, Ben Wilkinson

DURATION July 2023 - February 2024

FUNDING Fire Neural Network

Modeling tools for Species Status Assessments

The US Fish and Wildlife Service has a significant workload for conducting species status assessments to support listing, reclassification and recovery planning decisions under the Endangered Species Act (ESA). In many cases they lack the expertise or the tools to conduct the necessary scientific analyses and they need support in developing generalizable and transferrable tools to facilitate SSA analyses. We will work with the service to devise modeling tools that support SSA completion and work with the service specifically on two SSAs, the Texas spot-tailed earless lizard and the Round-tailed chub. Develop methods to analyze species status with sparse data, focusing on the utility of occupancy modeling and expert elicitation methods. We completed work on the round tailed chub viability assessment in June 2021. We developed a stochastic simulation model to predict stream occupancy in the future based on current occupancy and expert elicited parameters. Dr. Ashley Goode, designed a sized based life table analysis to use single capture event data to estimate survival and recruitment of the two species. Dr. Goode completed a threats linked stochastic viability model for the species, devised several scenarios based on cooperator input. The Chub viability model predicted low viability if the perceived threats continue into the future. We also ran additional scenarios with reduced threat effects to try and match field observations in recent years. The future viability results for the Texas lizard predict low probability of extinction over the next 20 years, but increase substantially at 50 years. Viability for the species was highly sensitive to road mortality and road density, and urban growth. The round tailed chub analyses are complete and the modeling that we did directly informed the decision to not list the species. The service chose not to use the viability modeling we did to support the listing decisions for two lizards in Texas. However, the tools we develop should be applicable to a variety of future SSAs with sparse data.

INVESTIGATOR Conor McGowan

POST-DOC Ashley Goode, WEC

DURATION July 2020 - September 2024

FUNDING USGS (RWO 315), USFWS

IN KIND SUPPORT Personnel provided by USFWS

SSA prioritization and science needs

The US Fish and Wildlife Service has a significant workload for conducting species status assessments to support listing, reclassification and recovery planning decisions under the Endangered Species Act (ESA). There are hundreds of pending decisions that require a science-based assessment of the species status before making ESA decisions. We will work with the service to devise an objectives hierarchy and tradeoffs analysis to develop a prioritization system for identifying which SSAs tasks require the most attention or effort, and when to do them. Develop an objectives hierarchy, identify measurable attributes and design a multi-criteria decision analysis value function to rank the >300 SSA project in the South East Region. In 2020 we sought and hired a post doc to fill the position and we initiated meetings with the management partners. We are taking a standard PROACT structured decision making approach to solve this problem and are guiding the Service thought the decision analysis steps. In spring of 2020, we conducted a series of team meetings with to elicit the prioritization objectives from field office supervisors and regional off deputies. Dr. Goode developed a optimization analysis that optimally schedules SSAs to maximize information quality, minimizes controversy constrained by court ordered deadlines and staffing capacity. We completed the analytical tool that addresses the project needs. We have tested output sensitivity to value function formulation and competing objective weights. We have also tested and demonstrated that the court ordered deadlines imposed by lawsuits against the service to force decision deadlines, reduces overall value. As a result of this work the Service can and has updated their work plan of SSAs in the coming years. They are also using the data collected to complete the optimization as a way to identify science needs in the future based on pending SSAs and available data.

INVESTIGATOR Conor McGowan

POST-DOC Ashley Goode, WEC

DURATION July 2020 - September 2024

FUNDING USGS (RWO 314), USFWS

IN KIND SUPPORT Personnel provided by USFWS

Sandhill Cranes. CONOR MCGOWAN

Bird conservation classification and assessment for the Southeastern United States

The US Fish and Wildlife Service has a is increasingly concerned with the loss of wild animals, contracting ranges and abundance declines and the SE region of the USFWS sought to develop a process of evaluating the success of conservation actions and make decisions about wildlife conservation prioritization (focusing on birds) going forward. In other words, how can they allocated time, effort and money towards conservation that maximized conservation impact while meeting other agency objectives? Develop methods for aligning conservation actions to agency objectives to maximize impact of the agency's effort. With the results of this project, the service can evaluate alternative funding allocations within the migratory bird and science applications programs with respect to bird conservation impact and other agency goals. Use decision analysis and group facilitation techniques to link agency actions to agency objectives and develop a framework for prioritizing actions and funding allocations within the program. We conducted a series of virtual structured decision-making workshops to elicit a problem statement, a objectives hierarchy and conceptual systems model. We used the hierarchy and conceptual models to build an optimization using Solver in MSExcel tool that seeks optimal allocation of staff time and effort to maximize conservation value. The tool we developed help the Assistant Regional Director for the SAMB program assess current staffing and how to adjust staff time and effort going forward. It also allows supervisors and managers to look at current achievement and set goals for the future. The assistant regional director and the deputy assistant regional director will use the prioritization framework to assess staff allocation options. Also, the Migratory Birds office in the southeast will be able to use the results of this work to evaluate proposals and projects annually to chose projects that best address bird conservation priorities.

INVESTIGATOR	Conor McGowan
POST-DOCS	Riley Andrade, WEC Ellen Pero, WEC
DURATION	April 2021 - September 2024
FUNDING	USGS (RWO 320), USFWS
IN KIND SUPPORT	Personnel provided by USFWS

Barbed Wire. DARCY DORAN-MYERS

Developing and evaluating tools for expert elicitation integration with Population Viability Models

Assessing the conservation status of at-risk species and predicting species' future trajectories helps to inform listing decisions under the Endangered Species Act. Species status assessments, however, often encounter significant data gaps. Analysts and modelers increasingly turn to expert elicitation to build their models. Questions remain regarding how reliable and accurate these methods are for filling data gaps in these decision settings. Do they represent the best available science and/or are there ways to improve these tools? We are devising methods to experimentally test expert elicitation methods, by comparing concealed data from American Black Bear research to expert elicitation data from panels of black bear experts. We also plan to use simulation modeling to test elicitation biases and explore the potential for AI to serve as an alternative tool for filling data gaps. Our goals are to: 1) develop methods and tools for integrating responses for multiple questions to estimate model parameters, 2) develop and improve tools for simulating populations with expert elicited parameters and 3) develop methods for testing accuracy of expert elicited parameter distribution and model predictions. We are in the early stages of implementing this project. Darcy Doran-Myers is gathering black bear spatial capture recapture data from across the species range to analyze and use in elicitation experiments. She has further been in contact with language model and deep learning AI experts to explore the potential for designing tools to fill endangered species data gaps. The work we complete will either endorse the effectiveness and accuracy of existing elicitation methods, suggest improvements to existing methods, or propose alternative approaches to filling critical data gaps in endangered species status assessments.

INVESTIGATOR	Conor McGowan
STUDENT	Darcy Doran-Myers, Ph.D., WEC
DURATION	January 2023 - September 2025
FUNDING	USGS (RWO 329), USFWS
IN KIND SUPPORT	USFWS

Least Bitterns. CONOR MCGOWAN

Science Applications and Migratory Bird program alignment in the Southeast

The US Fish and Wildlife Service recently merged the Science Applications program and the migratory birds (SAMB) program in the south east region under one assistant regional director. Aligning personnel and effort towards conservation objectives in this "new" SAMB program will enhance delivery and improve conservation outcomes, but requires careful thinking and objective evaluation. Develop methods for aligning conservation actions to agency objectives to maximize impact of the agency's effort. With the results of this project, the service can evaluate alternative staffing strategies and how to best allocate their effort and time toward program objectives. Use decision analysis and group facilitation techniques to link agency actions to agency objectives and develop a framework for staff Full-Time Equivalent (FTE) allocations within the program. We devised a program objectives hierarchy and identified measurable attributes for each fundamental objective of the program. We also estimated the expected relationship between staff time and effort and measurable attributes to use in an FTE optimization analysis. The tool we developed help the Assistant Regional Director for the SAMB program assess current staffing and how to adjust staff time and effort going forward. It also allows supervisors and managers to look at current achievement and set goals for the future. The assistant regional director and the deputy assistant regional director will use the prioritization framework to assess staff allocation options. Also, the Migratory Birds office in the southeast will be able to use the results of this work to evaluate proposals and projects annually to chose projects that best address bird conservation priorities.

INVESTIGATOR	Conor McGowan
POST-DOC	Ellen Pero, WEC
DURATION	January 2023 - September 2025
FUNDING	USGS (RWO 328), USFWS
IN KIND SUPPORT	Personnel provided by USFWS

Banded snail kite nestling. UNKNOWN

Demographic, movement, and habitat of the endangered Snail Kite in response to operational plans in Water Conservation Area 3A

The over-arching goals of this monitoring are to provide reliable information on population size and trends, as well as key demographic, habitat, and foraging information of relevance to the recovery of this species. Demographic analyses revealed that snail kite abundance drastically declined between 1999-2008. The period population decline coincided, in part, with drought conditions throughout the southern portion of the kites' range and water management changes. The objective of this research is to monitor the birds' response to environmental changes focusing on the most critical demographic parameters: survival, reproduction, recruitment, and population growth rate. Snail kites were monitored by performing band-resight surveys in various wetlands. Nests were also monitored and nestlings were banded with unique bands. A total of 339 active nests (i.e., containing eggs or nestlings) were located and monitored across the snail kite range in 2023. In 2023, the estimated population size was 2820 birds (95% confidence interval 2809-3166), which was very similar to 2022 (estimate: 2863, 95% confidence interval 2661-3146). Recent observed oscillations in annual population estimates may indicate that the population is near carrying capacity. Since the snail kite population is critically endangered and because adult fertility plays such an overwhelming role in the population growth rate, it is critical to identify and attempt to limit factors that negatively affect snail kite demography.

INVESTIGATORS	Robert Fletcher, Miguel Acevedo
STUDENT	Lara Elmquist, M.S., WEC
DURATION	September 2019 - September 2025
FUNDING	U.S. Army Corps of Engineers, SFWMD, FWC, St. Johns Water Management District

Evaluating the movement patterns and survival of juvenile Everglade Snail Kites (*Rostrahamus sociabilis plumbeus*) at Lake Okeechobee

Hydrologic alterations, degradation, and loss of wetland habitat are all factors that could have substantial effects on Snail Kite populations, including the survival of juvenile (1st year) individuals. Juvenile survival is a key factor for recovery of the species, but it is much less understood. Fine scale tracking information would allow us to better understand juvenile survival and movement, with the goal of providing information to inform management and promote 1st year survival of Snail Kites. Study objectives:

1) To determine causes of mortality in juvenile snail kites. Assess whether typical movement behaviors can be defined for a variety of environmental conditions
2) To identify threats that are most important to juvenile snail kite survival
3) To provide data on potential population sinks
4) To provide specific management recommendations for determining when and where to focus habitat management activities in order to increase population size through reduced mortality of young.

Deploying solar-powered transmitters and VHF trackers on Snails Kites fledglings so that we can understand both fine-scale movement, real-time mortality, and behavioral states of individuals. GPS/VHF transmitters were deployed on 24 fledglings from April 22nd to June 5th. Of these individuals, 3 individuals were confirmed dead and 3 additional individuals could not be confirmed but are presumed dead. Over the past 5 years the project tagged a total of 88 nestlings; 67 individuals with GPS-GSM/VHF and 21 with only VHF. Of these, 38 survived to 60 days, 31 had confirmed mortality and the remaining 19 individuals were unable to have their status confirmed. Based on GPS data retrieved from 11 individuals that survived to emigrate from the natal site in 2024, variation in movement patterns was substantial. Individuals traveled total distances of 958.2 ± 344.2 km and traveled as fast as 39.0 km/h. Within the nest site, patterns of movement also varied among individuals in terms of timing and distance traveled. Prior to emigration, we estimated home range areas of 0.03 ± 0.08 km2 and 0.08 ± 0.19 km2 using 90% and 99% kernel densities, respectively, which suggests small areas of use early in life. Birds primarily remained within 2.1 ± 1.0 km of the nest site for 45.7 ± 14.2 days after fledging. During that time, all birds occasionally embarked on looping foray flights from the nest site before returning. Regular attendance of the natal site ceased suddenly at approximately 28.5-77.5 days post-fledging and birds did not appear to return. Data generated from this study will provide information needed to allow for more targeted habitat and hydrologic management aimed at increasing juvenile survival of Snail Kites.

INVESTIGATORS	Robert Fletcher, Miguel Acevedo
STUDENT	Meghan Beatty, Ph.D., WEC
DURATION	September 2019 - September 2024
FUNDING	U.S. Army Corps of Engineers

Nestling snail kite with solar-powered GPS-GSM tag. CAROLINE POLI

Everglades, Florida. ANDY CHENG

Habitat connectivity for large mammals in the Greater Everglades

There is a global challenge in designing effective large-scale corridors to provide long-term habitat connectivity for multiple species with varying dispersal capacities. Corridor evaluations are scarce and a standardized approach is lacking. Implementing a standardized approach that accounts for the dispersal limitations of multiple species will offer a more comprehensive framework for assessing corridor effectiveness. This will provide valuable insights to policymakers and planners, guiding redesigns for underperforming corridors. This study aims to introduce a general multi-species approach using the 'spatial absorbing Markov chain' (SAMC) framework that accounts for the dispersal limitations of species to evaluate the effectiveness of the Florida Wildlife Corridor for a mammal community. It illustrates this framework´s utility for corridor evaluation by analyzing how well the corridor captures movement and its ability to enhance dispersal among protected areas. We integrate the SAMC with habitat suitability models and random-walk dispersal kernels to assess movement and dispersal for six mammal species across Florida Managed Areas (FLMAs). Our evaluation of the Florida Wildlife Corridor involved overlapping high movement values with the corridor and comparing settlement probabilities at FLMAs within and outside the corridor. Results indicate that species with limited dispersal capacity show greater overlap between predicted movement and the corridor while highly mobile species tend to move beyond the corridor's extent. However, the corridor's impact on settlement probability within FLMAs increased with dispersal distance, with no evident effect of the corridor for the species with the lowest dispersal capacity. The study emphasizes the limited impact of corridors on species with poor dispersal capacity due to their landscape isolation, highlighting the importance of incorporating dispersal metrics while evaluating corridors. The study advocates for a standardized approach that can be applied across broad scales to evaluate corridors and provide valuable insights for policymakers and planners.

INVESTIGATOR	Robert Fletcher
POST-DOC	María Eugenia Iezzi, WEC
DURATION	July 2023 - June 2024
FUNDING	USGS (RWO 331)

National Horizon Scan of terrestrial and aquatic plants

Biological invasions are one of the main drivers of biodiversity decline and have resulted in $1.26 trillion of economic losses in North America over the past 50 years. Early evaluation of a species' potential invasiveness can aid in prevention or early detection and rapid response by prioritizing the allocation of scarce management resources. International trade in agriculture, horticulture, and forestry species is the dominant pathway invasive plants have been introduced world-wide. With thousands of imported plants being brought into the U.S. each year through live plant trade, the U.S. needs a systematic examination of all plants in trade to anticipate which of these species have the potential to become invasive and cause future impacts. We will conduct a complete a horizon scan of Plants in Trade to provide a ranked list of potentially invasive aquatic and terrestrial plants, catalogue their primary ecological and socioeconomic impacts, and create habitat suitability models for high-risk species. We will also document management difficulty (e.g., herbicide resistance, lack of natural enemies). The end product will inform invasive species prevention and management prioritization (e.g., policymaking, early detection, rapid response). We will first pull a full list of aquatic and terrestrial plants that are currently in trade to the U.S. Species will be then organized by growth habit (e.g., trees and shrubs, aquatic floating, grasses/sedges, etc.). We currently have a list of over 70,000 plants in trade sourced from Law Enforcement Management and Information System (LEMIS), Dave's Garden, and PlantInfo.org. This list will be processed to remove species without a climate match, species with no naturalization or invasion history, and synonym correction. The resulting list will be distributed to working group participants. The working group will be comprised of a team leader and expert participants from research and management perspectives with a goal of 6-10 experts per group. Groups will complete rapid risk assessments, peer review, and within group consensus on rankings. Each teams list will be organized in a master list and sorted by score. All participants will meet to cross check rankings and reach a final consensus on the ranked list of invasive species threats. The final list can be used to prioritize species for full risk analysis (including comprehensive risk assessment and risk management), addition to watch lists, and possible regulation (e.g., noxious weed listing) to prevent import. Taxa ranked as low risk should not be considered for "whitelisting" as many of these species will require more research and pre- and post-border invasion risk assessment.

INVESTIGATORS	Deah Lieurance
DURATION	August 2022 - February 2024
FUNDING	USGS (RWO 326)

Florida Fish and Wildlife Conservation project on East Lake Toho. FWC

Life-size replicas of an eastern diamondback rattlesnake (Crotalus adamanteus), the invasive Burmese python (Python bivittatus) and a coyote (Canis latrans) deployed as visual cues in foraging experiments. A 45.7-cm traffic cone (not pictured) was also used in the novel object control. UNKNOWN

Understanding Greater Everglades mammal communities adjacent to and within the ARM Loxahatchee National Wildlife Refuge

Invasive predators pose a substantial threat to global biodiversity. Native prey species frequently exhibit naïveté to the cues of invasive predators, and this phenomenon may contribute to the disproportionate impact of invasive predators on prey populations. However, not all species exhibit naïveté, which has led to the generation of many hypotheses to explain patterns in prey responses. These hypotheses primarily fall into two categories: system-centric hypotheses related to biogeographic isolation (BIH) and species-centric hypotheses, like the archetype similarity hypothesis (ASH). We tested the predictions of these hypotheses by assessing the response of the common raccoon (*Procyon lotor*) and hispid cotton rat (*Sigmodon hispidus*), two native mammal species with divergent snake predation histories, to the cues of the invasive Burmese python (*Python bivittatus*) in the Florida Everglades (USA). Using giving-up densities (GUDs), we assessed the responses of both cotton rats and raccoons to life-size replicas of Burmese pythons and two North American predators—eastern diamondback rattlesnakes (Crotalus adamanteus) and coyotes (Canis latrans). Although cotton rats increased their GUD in the presence of all three predators relative to the novel-object control, raccoons only increased their GUD in coyote treatments. These results align with the predictions of the ASH but not the BIH, and mirror observed patterns of population declines in invaded areas of the Florida Everglades. More broadly, our findings suggest that naïveté may contribute to the vulnerability of some species to invasive predators even in large continental systems.

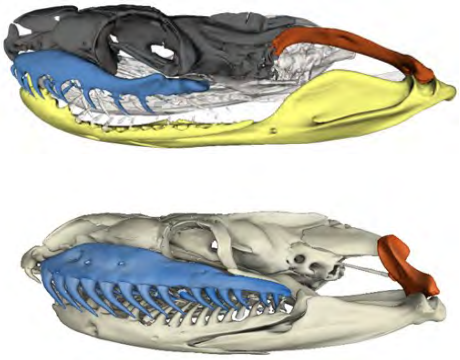
INVESTIGATOR Robert McCleery

POST-DOCS Rebecca McKee, WEC
Marina McCampbell, WEC

DURATION September 2018 - September 2024

FUNDING USGS (RWO 305)

IN KIND SUPPORT SFWMD, FWC



CT scans of skulls from a Brown treesnake (Boiga irregularis; top) and Burmese python (Python bivittatus; bottom) used for this project. Skull features to be assessed for signs of dietary-associated morphological change are highlighted in blue (maxilla), orange (quadrate), yellow (mandible), and black (cranium). KODIAK HENGSTEBECK

Invasive reptile adaptations and impacts

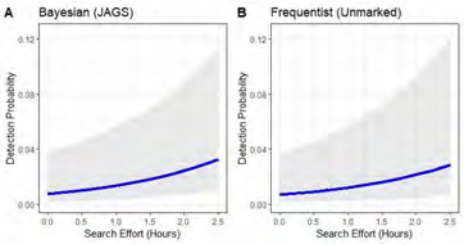
Burmese pythons are negatively impacting native wildlife across their range in southern Florida. Pythons in Florida have a broad diet, but the prey species composition differs across the landscape. Changes in life history traits of a species can result in plastic or adaptive responses such as morphological or behavioral change. Whether changes in prey species composition could result in phenotypic plasticity or adaptation in pythons is uncertain. Morphological adaptations can improve energy acquisition and aid in a species' establishment potential. If these changes in morphology occur in a short evolutionary timespan, the impact of the invader on natural resources may be dynamic. Relating morphology to prey use over time and space can help predict consequences of invaders on the ecosystem and identify native species at risk. The objective of this study is to assess plastic or adaptive responses by Burmese pythons to environmental change. Specifically, we will assess python skull morphology to explore any potential spatial or temporal variation. Data collected from >500 python specimens over the last 15 years from across their Florida range was used to document the amount of variation in phenotypic traits. All specimens were analyzed digitally using nano-CT technology. We used landmark-based geometric morphometrics to evaluate plastic or adaptative variations in python head shape over time and space. We used computed tomography at UF College of Engineering to produce high resolution 3-D digital models of python specimens for detailed morphometric analyses related to this study, and permanently stored these data for future research projects. In 2024, we also used these methods to assess invasive brown treesnake populations, CT scanning >150 specimens from their native and invasive ranges. Relating head morphology to prey use over time and space will improve researchers' ability to predict consequences of invasive pythons on other species of concern. Understanding the drivers and impacts of rapid morphological change of invasive species to introduced environments may justify intensive rapid response efforts for new species or populations before impact assessment can occur.

INVESTIGATOR Christina Romagosa

STUDENTS Kodiak Hengstebeck, Ph.D., SNRE

DURATION September 2019 - August 2024

FUNDING USGS (RWO 310)



Individual detection probability of a Burmese python given search effort in hours using a Bayesian estimation framework (A) and a frequentist estimation framework (B). DANIEL HARO

Using removal data to estimate Burmese python abundance in Everglades and Francis S. Taylor Wildlife Management Area

Abundance metrics are necessary for evaluation of invasive species management efforts, but they can be hard estimate for cryptic species and in situations where release of captured individuals runs counter to management efforts. Burmese pythons are highly cryptic non-native snakes which are currently managed through removal programs, but demographic information useful for evaluation of management programs remains unknown. Abundance estimates over time would allow for better understanding and evaluation of removal strategies. Our objectives are to use information collected by state agencies as part of their removal programs to fit abundance estimating models. By matching removal counts with site and survey specific covariates such as search effort (time spent searching), we have developed simple models which allow for estimates of abundance. We are currently evaluating the accuracy of these methods using simulated data, and we are expanding on these methods by taking movement and other natural processes into account. Early results suggest an extremely low detection probability (~1%) which is in accord with previous literature). Current abundance estimates are difficult to interpret because the spatial extent to which they apply is not properly defined given current model structure. Next steps are to use telemetry data to better define the spatial extent of resulting abundance estimates. Accurate abundance estimates will help evaluate removal program impacts. Eventually, estimates may be used to determine the most efficient removal strategies and locations, thereby reducing costs and increasing favorable impacts.

INVESTIGATOR Christina Romagosa

STUDENTS Daniel Haro, Ph.D., WEC

DURATION August 2021 - August 2026

FUNDING USGS (RWO 322), FWC, SFWMD

USGS Biologist Lisa McBride obtains a blood sample from a "Scout" python while Invasive Reptile Research Intern Grant McCargar restrains the animal. UNKNOWN

Targeting python reproduction and activity through hormonal patterns

We are exploring how Scout Snake (radio-tagged pythons) programs and python removal programs can be used to inform python management and efficacy. Information on life history, demography, and trophic-level impacts of invasive reptiles in Florida is still lacking, and abundance estimates are difficult. This information is critical for population ecology research and to evaluate management efficacy. From 2019 through 2024, we collected blood samples from free-ranging Burmese pythons tracked as part of the Scout project in order to understand seasonal hormone patterns and their role in python reproduction and behavior. These samples are being used to examine stress and sex hormone levels over time, providing key insights into the reproductive timing and physiological cycles of this invasive species. We are specifically measuring testosterone levels in male pythons throughout the year. During tracking efforts, we also document reproductive, exploratory, and foraging behaviors, allowing us to correlate hormone levels with observed activities. These data will help pinpoint optimal periods for targeted control efforts, such as removal or potential future hormone-based management techniques. Understanding the baseline endocrine patterns of wild pythons is crucial, as hormone fluctuations often drive behavior, knowledge that can significantly enhance predictive modeling and the development of innovative control methods.

INVESTIGATOR Christina Romagosa

STUDENTS Gabriela Logo, M.S., WEC

INTERNS Genesis Aponte Santiago, George Bancroft, Derek Biglin, Peter Crawford, Faith Dunlap, Cohen Eastridge, Carter Haley, Conor Joye, Eleanor Lane, Amelia Larroque, Grant McCargar, Sarah Payne, Josue Perez, Diana Rodas, Eli Suastegui, Madison Vasquez

DURATION August 2021 - August 2026

FUNDING USGS (RWO 322), WEC MS Assistantship

A tegu detected crossing between two trail cameras, investigating the laid scent trail. PETER XIONG

The role of scent lures on the detection of tegus

Argentine black and white tegus continue to expand their range in southern Florida, posing a serious threat to native wildlife, including recent incursions into Everglades National Park. As opportunistic omnivores, tegus consume eggs, small mammals, reptiles, and plants—placing several native and endangered species at risk. While live trapping remains a primary control strategy, limited understanding of the sensory cues that drive tegu trap detection hampers optimization efforts. Scent, a known foraging cue in reptiles, may offer an opportunity to enhance trap effectiveness if properly understood. This study evaluated whether scent lures could influence tegu detection rates along a camera trap array adjacent to Everglades National Park. We tested two commercially available scents—blueberry oil and mouse oil—at 24 camera sites along the C-111 canal system. Using Generalized Linear Mixed Models, we assessed changes in tegu detections pre- and post-treatment. Neither scent significantly affected detection rates, though mouse oil showed a marginal positive effect. We also found that relative humidity, marsh habitat, and trail camera brand influenced detection probabilities. While results were inconclusive, findings suggest scent may still play a role in tegu behavior, warranting further exploration. Refining scent selection and deployment methods may improve detection and trapping outcomes. As tegus continue to spread, innovative tools like scent-based lures could become critical for more effective early detection and removal strategies.

INVESTIGATOR Christina Romagosa

STUDENTS Peter Xiong, M.S., WEC

DURATION September 2022 - May 2025

FUNDING NPS

Adrian Figueroa. CHRISTINA ROMAGOSA

Invasive Species Prioritization Tool for the Office of Everglades Restoration Initiatives

Invasive species are a major threat to ecological restoration in the Greater Everglades Ecosystem. With limited funding and capacity, resource managers need a clear, data-driven approach to determine which species pose the greatest risk to restoration goals. There is currently no standardized method for prioritizing invasive species across large restoration programs. The absence of a repeatable and transparent system limits strategic decision-making and hampers coordination between agencies. The goal of this work was to develop a decision support tool that (1) ranks invasive species based on potential ecological harm, management feasibility, and restoration relevance, and (2) facilitates repeatable, science-based prioritization. We developed a scoring framework based on 59 science-based questions, drawing on expert input and literature. Each species was assessed and scored, and the tool automatically tallies a “Priority Score” to rank species. A complementary statistical model (GLM) was used to validate the prioritization and explore predictive accuracy. Eighty-seven species were evaluated across multiple taxonomic groups. The tool successfully identified high-priority species already under active management, as well as several overlooked threats. The GLM yielded >80% predictive accuracy, indicating strong alignment between expert-derived scores and underlying risk factors. This tool helps agencies target resources more effectively, streamlines cross-agency coordination, and provides a transparent record for how priorities were set. Future work will refine the tool based on stakeholder feedback and incorporate spatial and temporal dimensions to support long-term restoration planning.

INVESTIGATORS Adrian Figueroa, Luke Evans, Wesley Daniel, Christina Romagosa

DURATION December 2023 - December 2024

FUNDING Office of Everglades Restoration Initiatives, NPS

UF/USGS interns holding a female scout python in Big Cypress National Preserve after monthly sampling the snake for blood and weight. MATTHEW METCALF

Early detection of invasive tegu lizards in Everglades National Park via solar-powered cellular surveillance cameras and artificial intelligence

Invasive black and white tegus are emerging as a serious conservation concern in Everglades National Park (EVER). As dietary generalists, tegus pose a direct threat to ground-nesting species by consuming their eggs. Traditional methods of monitoring tegus are not feasible across the vast park, highlighting the need for innovative early detection and rapid response (EDRR) tools. To address this, our research team deployed solar-powered cellular trail cameras at two sites in EVER: one near the park entrance with high tegu density and another near Royal Palm Visitor Center with lower density. Each site was divided into a 1×1 ha grid, with cameras placed in 18 grid cells per site to monitor suitable habitat. To enhance detection, the team collaborated with Microsoft's Megadetector—an AI-based image classification tool—to develop a tegu-specific identification model. Although initial results showed only ~50% accuracy for tegu detection due to limited reptile training data, USGS FORT contributed nearly 2 million tegu images (2014–2022) to improve model performance. In 2024, interns manually reviewed over 20,000 camera images to assess Megadetector's accuracy and calculate false positive and negative rates. These metrics are critical for evaluating the tool's effectiveness in supporting real-time invasive species monitoring and improving EDRR strategies across the Everglades.

INVESTIGATOR	Christina Romagosa
STUDENT	Peter Xiong, TBD
INTERNS	Faith Dunlap, Carter Haley, Eleanor Lane, Gaby Silva, Sarah Payne, Madison Vasquez
DURATION	August 2024 - July 2029
FUNDING	USGS (RWO 334)

Research and science support for invasive Burmese pythons in Florida

The Scout Python Project combines targeted invasive species removal with vital research on Burmese python ecology in the Greater Everglades Ecosystem. By tracking radio-tagged "Scout" snakes during the breeding season, researchers locate and remove additional pythons while collecting key demographic data, such as movement patterns, survival, and reproduction. This collaborative effort, led by scientists from USGS (WARC and Fort Collins Science Center), the University of Florida, and the National Park Service, helps refine population models and inform more effective management strategies. In 2024, our team working along Loop Road in Big Cypress National Preserve documented rare maternal behavior in wild Burmese pythons. While brooding behavior, such as guarding and thermoregulating eggs, is well known, observations of maternal care beyond hatching have been limited in natural settings. Field cameras captured a female python returning to her nest during hatching and remaining with her offspring well into the following day, suggesting a stronger maternal investment than previously documented in southern Florida. This behavior could significantly influence hatchling survival and has important implications for population dynamics and future modeling. The team collected emerging hatchlings to track their survival over the first year of life, contributing to ongoing efforts to better understand python demography. These findings reinforce the importance of long-term, field-based research in shaping invasive species control strategies.

INVESTIGATOR	Christina Romagosa
STUDENT	TBD
INTERNS	George Bancroft, Enrique Ribas, Camille Klemann, Amelia Larroque, Derrick Biglin, and John Kaarli Rentof
DURATION	August 2024 - July 2029
FUNDING	USGS (RWO 333)

Burmese pythons (Python molurus bivittatus) removed from Big Cypress National Preserve, Ochopee, FL during the 2024–2025 breeding season. Panel A depicts a male (#1) and female (#2) python (white circles) as found in situ in a breeding aggregation. Panel B depicts the subsequent capture of these pythons by Camille Klemann (left; python #1) and Judith Baird-Lujano (right; python #2). Additional pythons found and removed this field season by the crew are pictured in panels C) Gènesis Aponte Santiago, D) Camille Klemann, and E) Camille Klemann (left), Genesis Aponte Santiago (right), and Enrique Ribas (center).

Invasive Reptile Research Internship Program. Tracking invasive Burmese pythons would not be possible without a large and dedicated crew. The 2024 intern biologists and USGS staff pictured above include: [first row, left to right]: Dr. Jackie Guzy, Derrick Biglin*, Judy Baird*, Amelia Larroque*, Lisa McBride^, [second row, left to right]: Grant McCargar^, Dr. Mark Sandfoss^, Eleanor Lane^, Conor Joye^, Carter Haley^, Sarah Payne^, Gaby Silva^, Diana Rodas^, Genesis Aponte Santiago*, [third row, left to right]: Sarah Sherburne^, Matt Metcalf^, Jose Torres*, Gretchen Anderson^. Symbols refer to affiliations: ^ FORT, * WARC.*

Everglades BioCorps and Invasive Reptile Research Internship Programs

The UF/IFAS Department of Wildlife Ecology and Conservation (WEC), in collaboration with Everglades National Park (EVER) and the U.S. Geological Survey, launched two innovative internship programs, the Everglades Biocorps Internship Program (est. 2016) and the Invasive Reptile Research Internship Program (est. 2014), to bridge a critical gap in hands-on experience among recent graduates of natural resource programs. These internships offer early-career biologists immersive training in both field and laboratory settings, all within the dynamic and ecologically significant Greater Everglades Ecosystem. Interns build essential skills in natural resource management, conservation, and applied research while expanding their professional networks and preparing for graduate studies or impactful careers in the natural resources sector. As these programs have evolved, so have the strong partnerships behind them—bringing together resource managers, researchers, and academic mentors to provide a rich, collaborative learning environment. Since their inception, the programs have supported students from the University of Florida and across the U.S., providing mentorship, research experience, and career-building opportunities that shape them into the next generation of biologists. The more than 150 alumni of the internship programs have pursued careers with federal and state agencies, non-profit organizations, or advanced degrees – many continuing to work within the Greater Everglades Ecosystem footprint. They enter the workforce with a strong foundation in restoration, agency operations, and complex ecological challenges. The skills developed through both internship programs are highly transferable beyond the Everglades ecosystem, preparing interns for diverse careers in natural resource management, conservation, and the biological sciences.

The Everglades BioCorps Internship Program (est. 2016), a collaboration between the University of Florida and the National Park Service, offers undergraduates and recent graduates—both from UF and beyond—hands-on experience in ecological research and resource management. Interns support Everglades National Park (EVER) through fieldwork and data collection while gaining valuable skills in conservation, restoration, and invasive species management. Everglades BioCorps interns have contributed to a wide range of efforts, including sea turtle monitoring, fish surveys, wetland restoration, and invasive plant and reptile management. Each summer, 1–3 "flex" interns, current UF students or recent graduates, are selected directly from Dr. Christina Romagosa's course, Everglades Natural History, Management, and Restoration. These students gain field exposure through an immersive trip to the Everglades, where they meet current interns from both internship programs and get a firsthand look at ongoing projects. This experience prepares flex interns to contribute immediately and meaningfully to EVER's monitoring efforts. Many interns continue their work beyond the summer, returning for extended internships or technician roles, helping to shape the next generation of Florida's natural resource professionals.

The Invasive Reptile Research Internship Program (est. 2014), developed in partnership with the U.S. Geological Survey Fort Collins Science Center, is a core initiative for training early-career biologists in applied invasive species research. In 2022, the program expanded with support from the USGS Wetland and Aquatic Research Center, forming a dynamic research team tackling high-priority conservation and management work. Interns have played a key role in studying Burmese pythons and black and white tegu, two of the most damaging invasive reptiles in the Greater Everglades Ecosystem. Intern contributions include research on python ecology and management, movement, reproduction, survival, and disease, as well as aiding in early detection and removal efforts for tegus. This research continues to fill critical knowledge gaps essential for effective invasive reptile species management. Many alumni have gone on to graduate school, contributed to scientific research, and established meaningful careers in conservation and natural resources, demonstrating the program's success as a launchpad for the next generation of scientists.

INVESTIGATOR	Christina Romagosa
STUDENTS	Daniel Haro, Ph.D., WEC Gabriela Logo, M.S., WEC Kate Davis, Ph.D., Zoology Shelby LeClare, M.S., SNRE Peter Xiong, M.S., WEC
INTERNS	**Everglades Biocorps:** Dylan Withee, Adriana Abaunza, Grace Schuppie, Carly Spading, Zackary Botkin, Sophie Trask **Invasive Reptile Research Internships:** Genesis Aponte Santiago, George Bancroft, Derek Biglin, Peter Crawford, Faith Dunlap, Cohen Eastridge, Carter Haley, Conor Joye, Eleanor Lane, Amelia Larroque, Grant McCargar, Sarah Payne, Josue Perez, Diana Rodas, Gaby Silva, Eli Suastegui, Madison Vasquez
DURATION	August 2014 - August 2029
FUNDING	USGS (RWO 334), NPS

Publications

Student authors denoted in **bold**. Coop Unit scientists underlined

Bartoszek, I. A., **K. C. Hengstebeck**, I. Easterling, M. Bassis, and C. M. Romagosa. 2024. Subterranean refuge use by Burmese pythons in southwestern Florida. Journal of Herpetology 58(3):209-220. https://doi.org/10.1670/21-064

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Gregory, Kaili M., Cat Darst, Samantha M. Lantz, Katherine Powelson, Conor P. McGowan. 2024. Effects of drought, invasive species, and habitat loss on future extinction risk of two species of imperiled freshwater turtle, Climate Change Ecology, Volume 7, 100078, ISSN 2666-9005. https://doi.org/10.1016/j.ecochg.2023.100078

Herren, R.M. and J.R. Schmid. In Press. Capturing and handling sea turtles (>25cm SCL). In: Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication.

Machado-Stredel, F., P. J. Atauchi, C. Nuñez-Penichet, M. E. Cobos, L. Osorio-Olvera, A. Khalighifar, T. P. Peterson, & R. J. Fletcher, Jr. 2024. The roles of abiotic and biotic factors in driving range shifts: An invasive Pomacea snail facilitates Rostrhamus *sociabilis* (Snail Kite) northward range expansion. Ornithology, 141(3), ukae022. https://doi.org/10.1093/ornithology/ukae022

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McKee, R. K., P. J. Taillie, K. M. Hart, C. L. Lopez, A. Sanjar, & R. A. McCleery. 2024. Ecological function maintained despite mesomammal declines. Scientific Reports, 14(1), 19668. https://doi.org/10.1038/s41598-024-66534-8

Parker, S. W., W. E. Pine III, B. Healy, and J. Hines. In-Press. Population growth of threatened Gulf Sturgeon may be limited by the frequency of adult episodic mortality events. Marine and Coastal Fisheries.

Parker, S. W., W. E. Pine III, **K. A. Wilkinson**, A. Breton, J. Vine, S. Rider, D. Fox, and J. Heublein. In-Review. Juvenile Gulf Sturgeon survival estimation in the Choctawhatchee River and Bay system using telemetry recaptures and multistate modeling. North American Journal of Fisheries Management.

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Student authors denoted in **bold**. Coop Unit scientists underlined

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Belted Kingfisher. MADISON HEISEY

Presentations

Student authors denoted in **bold**. Coop Unit scientists underlined

Anderson, C. C. and A. K. Carlson. Thermal habitat suitability for non-native fish in Florida's lotic systems. Fisheries and Aquatic Sciences Graduate Student Symposium, University of Florida, Gainesville, Florida. March 2024.

Anderson, C. C. and A. K. Carlson. Thermal habitat suitability for non-native fish in Florida's lotic systems. Florida Cooperative Fish and Wildlife Research Unit Coordinating Committee Meeting, Gainesville, Florida. April 2024.

Araya, P., **P. Xiong**., M. Harmon, A. Figueroa, L. Hussain, **J. Broxton**, R. R. Carthy, and C. Romagosa. Investigating the seed dispersal mechanisms of plant seeds in tegu (*Salvator merianae*), diet samples in Everglades National Park. Poster presentation at The Wildlife Society meeting, Baltimore Maryland. 2024.

Beatty, M. A., **L. Elmquist**, **B. M. Jeffery**, C. Poli, R. J. Fletcher. Saving the snail kite: invasive prey and novel ecosystems promote population recovery. Invited Talk. American Ornithological Society Annual Meeting. 2024.

Beatty, M. A., R. J. Fletcher. The use of social information in an endangered raptor. Oral Presentation. American Ornithological Society Annual Meeting. 2024.

Beatty, M. A., I. V. Brack, R. D. Holt, D. Valle, R. J. Fletcher. An invasive prey disrupts long-term source-sink dynamics of an endangered predator. Oral Presentation. The Wildlife Society Annual Conference. 2024.

Beatty, M. A., R. J. Fletcher. The use of social information in an endangered raptor. Poster. Florida Fish & Wildlife Conservation Commission Annual Meeting. 2024.

Bonvechio, K. I., C. P. Shea, and A. K. Carlson. Work smarter, not harder: using data simulations to inform sampling decisions. Fisheries and Aquatic Sciences Graduate Student Symposium, University of Florida, Gainesville, Florida. March 2024.

Bonvechio, K. I., C. P. Shea, and A. K. Carlson. Work smarter, not harder: using data simulations to inform sampling decisions. Florida Cooperative Fish and Wildlife Research Unit Coordinating Committee Meeting, Gainesville, Florida. April 2024.

Carthy, R. R. Drones applications for wildlife and habitat surveys. Invited lecture in SUR4376/6377, Applications of UAS Mapping. University of Florida. 2024.

Davis, K.R., C. J. Campbell, S. Tillis, C. M. Romagosa, H. B. Vander Zanden. Determining the Origin of Migrating Birds Consumed by Burmese Pythons While Overwintering in Florida. In Invasive Science Research Symposium. University of Florida, Gainesville, FL, USA. May 6-8, 2024.

Davis, K.R., C. J. Campbell, S. Tillis, C. M. Romagosa, H. B. Vander Zanden. Determining the Origin of Migrating Birds Consumed by Burmese Pythons While Overwintering in Florida. Oral Presentation. The Wildlife Society Annual Conference. Baltimore, MD, USA. October 19-23, 2024.

Elmquist, L., R. J. Fletcher. Impacts of boating activity on foraging and breeding snail kites. Oral Presentation. Florida Ornithological Society Fall Meeting. 2024.

Elmquist, L., R. J. Fletcher. Impacts of boating activity on foraging and breeding snail kites. Poster. Annual Meeting of the American Ornithological Society Meeting. 2024.

Figueroa, A., L. Evans, W. Daniel, and C. M. Romagosa. Invasive species prioritization tool update. Office of Everglades Restoration Initiatives Joint Working Group (WG) and Science Coordination Group (SCG) Meeting. Davie & West Palm Beach, FL. July & October 2024.

Figueroa, A., L. Evans, W. Daniel, and C. M. Romagosa. Invited talk. Leveraging R Shiny and stakeholder engagement to develop a nonnative species prioritization tool. 2024 Everglades Cooperative Invasive Species Management Area - Everglades Invasive Species Summit, Davie FL. June 2024.

Gonzalez, D., **P. Xiong**, L. Hussain, **J. Broxton**, R. R. Carthy, and C. Romagosa. Assessing non-target species interference in camera trapping: Implications for tegu trapping. Poster presentation at The Wildlife Society meeting, Baltimore Maryland. 2024.

Guzy, J. C., M. R. Sandfoss, A. M. Kissel, M. F. McCollister, C. M. Romagosa, A. A. Yackel Adams, and K. M. Hart. 2024. U.S. Geological Survey Nonnative Wildlife Research Updates. 2024 Everglades Cooperative Invasive Species Annual Summit, Davie, FL. June 25-26, 2024.

Hart, K. M., A. A. Yackel Adams, J. C. Guzy, M. R. Sandfoss, A. M. Kissel, M. E. Hunter, M. F. McCollister, and C. M. Romagosa. 2024. Python vital rates to inform management options: a collaborative approach. U.S. Army Corps of Engineers Virtual Information Exchange, virtual meeting. June 17, 2024.

Presentations

Student authors denoted in **bold**. Coop Unit scientists underlined

Haro, D., A. A. Yackel Adams, N. J. Hostetter, and C. M. Romagosa. A multinomial N-mixture model to estimate population size of Burmese Pythons. Presentation for the University of Florida Cooperative Research Unit. Gainesville, FL, USA. April 23, 2024.

Haro, D., N. J. Hostetter, A. A. Yackel Adams, A. F. Currylow, F. J. Mazzotti, M. M. Miller, S. N. Smith, M. R. Sandfoss, B. L. Welty, and C. M. Romagosa. Using removal data to estimate abundance of invasive species to inform management decisions. In Invasive Science Research Symposium. University of Florida, Gainesville, FL, USA. May 6-8, 2024.

Hengstebeck, K. C., and C. M. Romagosa. Oral Presentation. Investigating the Multifarious Impacts of Animal Invasions. University of Florida School of Natural Resources and Environment Seminar Series. Gainesville, FL. November 18, 2024.

Herren, R.M. and G. Roth. Health assessments and growth rates of green turtles in Bermuda's waters: A comparison with green turtles captured in Florida. Bermuda Zoological Society Science Series. Bermuda Aquarium Museum and Zoo. August 2024.

Lane, E., S. Payne, C. Haley, G. Silva, F. Dunlap, M. Vasquez, M. Metcalf, C. Romagosa, M. Harman, K. Donmoyer, L. McBride, S. Sherburne, A. Kissel, A. Yackel Adams, and M. Sandfoss. Preliminary summary of endo-parasite communities of native snakes from road cruise surveys on Main Park Road in Everglades National Park. In Herpeton Conference. Fort Myers, FL, USA. September 27-29, 2024.

Martucci, E., **L. Elmquist**, L. Hussain, **P. Xiong**, **J. Broxton**, R. R. Carthy, C. Romagosa, and R. Fletcher. Mapping boat activity: Comparing boat counts between peak recreational events and snail kite surveys. Poster presentation at The Wildlife Society meeting, Baltimore Maryland. 2024.

Masterson, L. M., B. C. Thompson, and A. K. Carlson. Investigating habitat use, movement, emigration, and survival of Grass Carp stocked to control hydrilla in large Florida lakes. Fisheries and Aquatic Sciences Graduate Student Symposium, University of Florida, Gainesville, Florida. March 2024.

Masterson, L. M., B. C. Thompson, and A. K. Carlson. Investigating habitat use, movement, emigration, and survival of Grass Carp stocked to control hydrilla in large Florida lakes. Florida Cooperative Fish and Wildlife Research Unit Coordinating Committee Meeting, Gainesville, Florida. April 2024.

McCargar, G., G. Aponte-Santiago, C. Joye, D. Rodas, M. Metcalf, L. McBride, S. Sherburne, M. Sandfoss, A. Kissel, C. Romagosa, M. McCollister, and A. Yackel Adams. Arboreal behavior in Burmese pythons. In Herpeton Conference. Fort Myers, FL, USA. September 27-29, 2024.

Metcalf, M., L. M. McBride, S. R. Sherburne, G. Aponte-Santiago, J. Baird, J. Torres, M. R. Sandfoss, J. C. Guzy, A. M. Kissel, C. M. Romagosa, M. F. McCollister, K. M. Hart, and A. A. Yackel Adams. Project updates and upcoming objective goals of radio -tracking Burmese pythons in the Big Cypress National Preserve. In Herpeton Conference. Fort Myers, FL, USA. September 27-29, 2024.

Miller, K. A., E. Lundy, **C. E. Myles-McBurney**, and A. K. Carlson. Preliminary assessment of habitat suitability and microhabitat use of imperiled Bluenose Shiners in Florida rivers. Fisheries and Aquatic Sciences Graduate Student Symposium, University of Florida, Gainesville, Florida. March 2024.

Miller, K. A., E. Lundy, **C. E. Myles-McBurney**, and A. K. Carlson. Preliminary assessment of habitat suitability and microhabitat use of imperiled Bluenose Shiners in Florida rivers. Florida Cooperative Fish and Wildlife Research Unit Coordinating Committee Meeting, Gainesville, Florida. April 2024.

Miller, M., B. Welty, S. N. Smith, A. A. Yackel Adams, C. M. Romagosa, **D. Haro**, M. R. Sandfoss, A. F. Currylow, N. J. Hostetter, and F. J. Mazzotti. Linking Burmese Python Ecology with Removal Efforts in the Everglades. In Invasive Science Research Symposium. University of Florida, Gainesville, FL, USA. May 6-8, 2024.

Myles-McBurney, C. E., J. H. O'Connor, and A. K. Carlson. Diel or no diel? Research evaluating gravel-bar fish assemblages in the Escambia River in relation to season, depth, and time of day. Fisheries and Aquatic Sciences Graduate Student Symposium, University of Florida, Gainesville, Florida. March 2024.

Poster Session at 2024 CCM. ABBY POWELL

Presentations

Student authors denoted in **bold**. Coop Unit scientists underlined

Parker S. W., L. G. Coggins Jr, B. T. van Poorten, and W. E. Pine. A range-wide assessment of Gulf Sturgeon population viability using a metapopulation approach. Best Student Presentation Nominee. Southern Division American Fisheries Society Annual Meeting, Chattanooga, Tennessee. February 2, 2024.

Parker S. W., **K. A. Wilkinson**, A. R. Breton, and W. E. Pine. Maximizing learning opportunities through data workflow modernization: a case history of Gulf Sturgeon monitoring. Southern Division American Fisheries Society Annual Meeting, Chattanooga, Tennessee. February 2, 2024.

Payne, S., E. Lane, C. Eastridge, J. Perez, E. Suastegui, G. Bancroft, D. Biglin, J. Rentof, M. Metcalf, L. McBride, S. Sherburne, G. Aponte-Santiago, J. Baird, J. Torres, J. Guzy, A. Kissel, A. Yackel Adams, C. Romagosa, M. McCollister, K. Hart, and M. Sandfoss. Nesting behaviors of Burmese pythons in the Big Cypress National Preserve. In Herpeton Conference. Fort Myers, FL, USA. September 27-29, 2024.

Pine, W. E. and **S. W. Parker**. Population growth of threatened Gulf Sturgeon may be limited by the frequency of adult episodic mortality events. Southern Division American Fisheries Society Annual Meeting. Chattanooga, Tennessee. February 2, 2024.

Powell, Abby N. and Kevin Kalasz. Another piece of the puzzle: Identifying sites important to young Red Knot. Western Hemisphere Shorebird Group Meeting, Sackville, NB, Canada. August 15, 2024.

Powell, Abby N., **K. Zhang,** and **C. Gulick**. Movement ecology of white ibis and tricolored herons from breeding colonies in coastal Alabama. Seminar presented to the DOI Gulf Restoration Team. February 22, 2024.

Romagosa, C. M., B. Baiser, F. J. Mazzotti, R. W. Snow, I. Bartoszek, C. J. Dove, **A. Diego Juárez-Sánchez**, E. Suarez, M. Rochford, J. M. Josimovich, A. A. Yackel Adams, M. S. Cherkiss, J. C. Guzy, G. Falk, J. Dixon, M. R. Sandfoss, A. F. Currylow, K. M. Hart, and R. N. Reed. Prey Species Composition, Richness, and Diversity of Burmese Python Diet in Florida. In Invasive Science Research Symposium. University of Florida, Gainesville, FL, USA. May 6-8, 2024.

Roy, F., **L. Elmquist**, **J. Broxton**, L. Hussain, **P. Xiong**, R. R. Carthy, C. Romagosa, and R. Fletcher. Potential boat interactions between recreational boating and snail kite (*Rostramus sociabilis plumbeus*) nesting. Poster presentation at The Wildlife Society meeting, Baltimore Maryland. 2024.

Sandfoss, M. R., A. M. Kissel, S. R. Sherburne, J. C. Guzy, L. M. McBride, G. E. Anderson, J. A. Torres, C. M. Romagosa, A. F. Currylow, M. F. McCollister, K. M. Hart, and A. A. Yackel Adams. Spatial ecology of juvenile Burmese pythons in their invasive range, Big Cypress National Preserve, FL, USA. In Invasive Science Research Symposium. University of Florida, Gainesville, FL, USA. May 6-8, 2024.

Sandfoss, M. R., A. M. Kissel, S. R. Sherburne, J. C. Guzy, L. M. McBride, G. E. Anderson, J. A. Torres, C. M. Romagosa, A. F. Currylow, M. F. McCollister, K. M. Hart, and A. A. Yackel Adams. Spatial ecology of juvenile Burmese pythons in their invasive range, Big Cypress National Preserve, FL. In Everglades Cooperative Invasive Species Annual Summit. Long Key Natural Area and Nature Center, Davie, FL, USA. June 25-26, 2024.

Sandfoss, M. R., A. M. Kissel, S. R. Sherburne, J. C. Guzy, L. M. McBride, G. E. Anderson, J. A. Torres, C. M. Romagosa, A. F. Currylow, M. F. McCollister, K. M. Hart, and A. A. Yackel Adams. Spatial ecology of juvenile Burmese pythons in Big Cypress National Preserve, FL, USA. In FISC Annual Conference. Melbourne, FL, USA. April 10-12, 2024.

Scott, A. M., and A. K. Carlson. A new water temperature modeling approach to predict thermal habitat suitability for nonnative cichlids in Florida rivers. Florida Cooperative Fish and Wildlife Research Unit Coordinating Committee Meeting, Gainesville, Florida. April 2024.

Wooley, A. K., G. R. Poulakis, Z. A. Siders, and A. K. Carlson. Ontogenetic shifts in habitat use and home range of juvenile Smalltooth Sawfish in a southwest Florida nursery. Fisheries and Aquatic Sciences Graduate Student Symposium, University of Florida, Gainesville, Florida. March 2024.

Yackel Adams, A. A., K. M. Hart, M. R. Sandfoss, J. C. Guzy, A. M. Kissel, L. M. McBride, G. E. Anderson, J. A. Torres, M. F. Metcalf, S. R. Sherburne, M. E. Hunter, M. F. McCollister, and C. M. Romagosa. Collaborative Research on Invasive Burmese Pythons to Inform Management Strategies to Preserve Everglades Biodiversity. Colorado State University. Fort Collins, CO, USA. February 27, 2024.

Yackel Adams, A. A., K. M. Hart, M. R. Sandfoss, J. C. Guzy, A. M. Kissel, L. M. McBride, G. E. Anderson, J. A. Torres, M. F. Metcalf, S. R. Sherburne, M. E. Hunter, M. F. McCollister, and C. M. Romagosa. Collaborative Research on Invasive Burmese Pythons to Inform Management Strategies to Preserve Everglades Biodiversity. In NISAW Webinar: Annual USGS Invasive Species Seminar (ca. 237 participants). February 26, 2024.

Theses and Dissertations

Trenton Aguilar, Ph.D., 2024
Predicting future population impacts of vessel strikes on green turtle populations using empirical and modeling approaches.

Kodiak Hengstebeck, Ph.D., 2024
Multifarious Impacts of Animal Invasions

Shelby LeClare, M.S., 2024
Effects of an Invasive Top Predator on Ecosystem Structure and Function: A Comparison of the Greater Everglades Graminoid Marsh Food Web before and after the Burmese Python Invasion

Kodiak Hengstebeck and Christina Romagosa at graduation. CHRISTINA ROMAGOSA

Treton Aguilar at graduation. RAYMOND CARTHY

Completed Projects

Predicting Future Population Impacts of Vessel Strikes on Green Turtle Populations Using Empirical and Modeling Approaches
Investigators: Raymond Carthy, Trenton Aguilar, Mike Allen. Completion Date: August 2024. Funding Agency: NSF, Florida Education Fund, UF Graduate School, McKnight Doctoral Fellowship, Sea Turtle Conservancy

Investigating Grass Carp movement, habitat use, emigration, and natural mortality after stocking in the Harris Chain of Lakes, Florida
Investigator: Andrew Carlson. Completion Date: June 2024. Funding Agency: FWC

Ecology and conservation of endangered Smalltooth Sawfish
Investigator: Andrew Carlson. Completion Date: December 2024. Funding Agency: FWC, NOAA

Evaluating a habitat suitability index for Bluenose Shiner populations in peninsular and panhandle Florida rivers
Investigator: Andrew Carlson. Completion Date: December 2024. Funding Agency: FWC

Informing Gulf Sturgeon population status and trends as a baseline to measure PDARP actions to promote species recovery
Investigators: Bill Pine, Andrew Carlson. Completion Date: December 2024. Funding Agency: NOAA and USFWS (RWOs 308 and 313)

Building rural wildfire resilience through GIS mapping and UAV verification of High-Risk-Lightning strikes
Investigators: Raymond Carthy, Peter Ifju, Ben Wilkinson. Completion Date: February 2024. Funding Agency: Fire Neural Network

Modeling Tools for Species Status Assessments
Investigator: Conor McGowan. Completion Date: September 2024. Funding Agency: USGS (RWO 315), USFWS

SSA prioritization and science needs
Investigator: Conor McGowan. Completion Date: September 2024. Funding Agency: USGS (RWO 314), USFWS

Bird conservation classification and assessment for the Southeastern United States
Investigator: Conor McGowan. Completion Date: September 2024. Funding Agency: USGS (RWO 320), USFWS

Evaluating the Movement Patterns and Survival of Juvenile Everglade Snail Kites (Rostrahamus sociabilis plumbeus) at Lake Okeechobee
Investigators: Robert Fletcher, Miguel Acevedo. Completion Date: September 2024. Funding Agency: U.S. Army Corps of Engineers

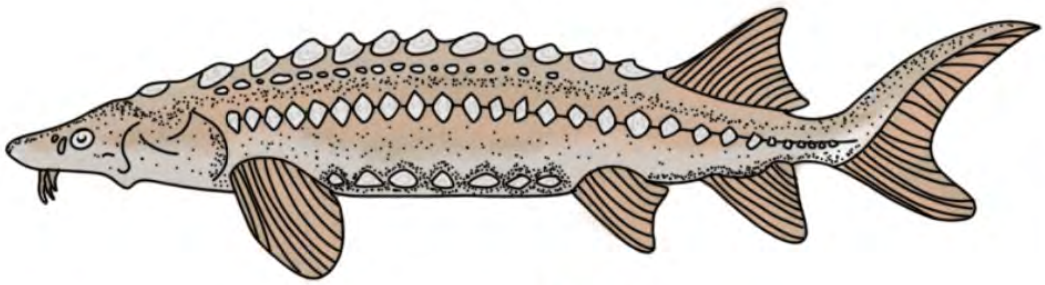
Habitat connectivity for large mammals in the Greater Everglades
Investigator: Robert Fletcher. Completion Date: June 2024. Funding Agency: USGS (RWO 331)

National Horizon Scan of terrestrial and aquatic plants
Investigator: Deah Lieurance. Completion Date: February 2024. Funding Agency: USGS (RWO 326)

Understanding Greater Everglades mammal communities adjacent to and within the ARM Loxahatchee National Wildlife Refuge
Investigator: Robert McCleery. Completion Date: September 2024. Funding Agency: USGS (RWO 305)

Invasive reptile adaptations and impacts
Investigator: Christina Romagosa. Completion Date: August 2024. Funding Agency: USGS (RWO 310)

Invasive Species Prioritization Tool for the Office of Everglades Restoration Initiatives
Investigator: Christina Romagosa. Completion Date: December 2024. Funding Agency: Office of Everglades Restoration Initiatives, NPS



Atlantic Sturgeon. MARIAGUADALUPE VILCHEZ

2024 Photo Contest Winners

Animals:

Stay Back. NICK ASREEN

People:

Late Night Herping. JAZMYN BROXTON

Landscapes:

Playing in Muddy Water. JAZMYN BROXTON

Alumni Spotlight:

Keara Clancy

Christina Romagosa and Keara Clancy at graduation.

Keara Clancy, Spencer Zeitoune, Mariaguadalupe Vilchez at CrEEK Family Fest. ALISON BLAKESLEE

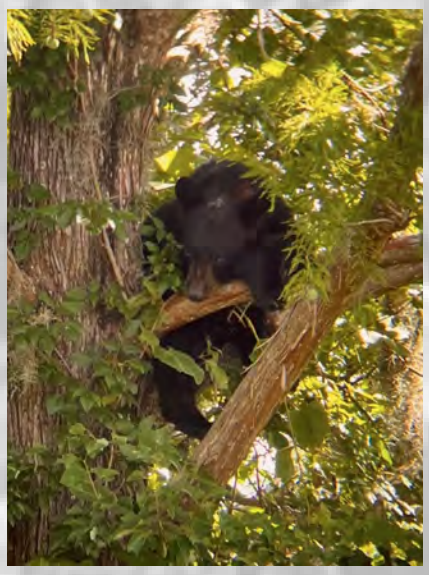
Keara Clancy started out as a Doris Duke Conservation Scholar in 2018. She then went on to complete her Master's in Dr. Romagosa's Florida Invasion Ecology Lab in 2022. Afterwards, she joined Alachua Conservation Trust as the Program Coordinator of the Creekside Environmental Ed for Kids (CrEEK) Program. Through the program, Keara provides no-cost environmental education to students from low-income backgrounds in Alachua and Putnam counties to bolster science literacy and foster an appreciation for the outdoors. Since filing the role as program coordinator, Keara has grown the number of students the program serves each year from 400 over 1,700.

The CrEEK Program's theme is "I am a Scientist!," and Keara uses her background in Wildlife Ecology to teach K-12 students about different methods of wildlife sampling, habitat monitoring, and data collection. The program takes place at Little Orange Creek Nature Park in Hawthorne, Florida, where students have the opportunity to dipnet for aquatic life, sweep net for terrestrial invertebrates, track wildlife, and catalog botanical wonders.

The program hosts interns every semester, with 20 total University of Florida students contributing 120 hours each to the program since the internship launched in Spring 2024. By connecting back to the University of Florida, Keara sees an opportunity to mentor students in the same valuable way that she received during her time at UF.

Students on CrEEK Program field trips. KEARA CLANCY

ACT Environmental Education Interns from the first cohort in Spring 2024. UNKNOWN



Top Left: *Black bear on Mowry Road. ABBY POWELL*

Top Right: *UF interns Camille Klemman and Enrique Ribas getting morphometric measurements of male scout python. JUDITH BAIRD LUJANO*

Center: *Naples Zoo Veterinarian captured an alligator skull in a female scout python from Big Cypress National Preserve. NAPLES ZOO*

Bottom Left: *Column Stinkhorn in front of 2295 Mowry Road. ABBY POWELL*

Bottom Right: *Miilkweed. KATE DAVIS*

Back Cover: *Pop ash forest during dry season. JUDITH BAIRD LUJANO*

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Florida Fish and Wildlife Conservation Commission

United States Geological Survey

United States Fish and Wildlife Service

University of Florida

Wildlife Management Institute