INVASION SCIENCE RESEARCH SYMPOSIUM

MAY 6-8, 2024

GAINESVILLE, FL

PROGRAM & ABSTRACTS

UF IFAS UNIVERSITY of FLORIDA

ISRI INVASION SCIENCE RESEARCH INSTITUTE

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INVASION SCIENCE RESEARCH SYMPOSIUM

MAY 6-8, 2024

J. Wayne Reitz Union
University of Florida
Gainesville, FL

conference.ifas.ufl.edu/invasion
invasionscience.ufl.edu

WiFi Network: "ufguest"

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TABLE OF CONTENTS

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Invasive species represent one of the greatest contemporary threats to biodiversity, affecting diverse natural environments, causing extensive economic damage, and impacting quality of life worldwide. Florida is no exception, and indeed is 'ground zero' for invasive species in the US. Currently, Florida's ecosystems support established populations of more than 500 non-native fish and wildlife species, 1,300 non-native plants, and thousands of non-native lower life forms, including insects, mites, nematodes, fungi, and microbes. Moreover, the rate of introduction of new invasive species continues to increase. Not all these species will necessarily flourish, but those that do have the potential to cause massive ecological and economic disruption across farmland, natural areas, and urban landscapes. The overarching goal of the Invasion Science Research Institute is to address this challenge.

To learn more about the Invasion Science Research Institute, visit **invasionscience.ufl.edu.**

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ISRI
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WELCOME INVASION SCIENCE COLLEAGUES,

Thank you for joining us for the 2024 Invasion Science Research Symposium!

Invasive species continue to devastate fisheries, forestry and agriculture, cause health epidemics, erode biodiversity, and threaten endangered species. The problems are often complex and multidimensional, yet our approach to their management is often piecemeal and reliant on single disciplinary perspectives. To help address this challenge, in 2023 the University of Florida launched the Invasion Science Research Institute (ISRI), with the goal of transforming understanding and management of invasive species. The institute aims to synergize the significant research activities that exist across UF and its many partners by providing a 'horizontal' structure that traverses the traditional 'vertical', disciplinary-based silos.

Invasion science delves deeper than merely addressing individual invasive species. The institute is built on a foundation of four strategic aims: 1) Strengthen the research community; 2) Nurture early career invasion scientists; 3) Facilitate interdisciplinary research to advance our understanding and inform novel policies for prevention and management; and 4) Enhance knowledge exchange to improve the relevance, profile, and impact of invasion science.

With these aims in mind, it is a great pleasure to welcome you to our first Invasion Science Research Symposium. We have an exciting program with two full days of presentations and posters spanning many systems and approaches. Our ambition is that this symposium will become a regular feature and establish itself as one of the 'go to' meetings for the invasion science community. We invite you to listen, interact, reflect, and learn. We also hope you'll have fun!

Sincerely,

Matthew Thomas

Matthew B. Thomas
Symposium Chair

Professor & Director
Invasion Science Research Institute
University of Florida

UF IFAS
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PROGRAM COMMITTEE

Matthew B. Thomas

Symposium Chair

Professor and Director
Invasion Science Research Institute
University of Florida

Matthew is from the UK and obtained his degrees from the University of Cardiff and the University of Southampton. He has held tenured positions at Imperial College London, CSIRO in Australia, the Centre for Infectious Disease Dynamics and Department of Entomology at Penn State University in the US, and most recently served as the Director of the York Environmental Sustainability Institute at the University of York in the UK. In late 2022 he returned to the US to take up the exciting new challenge of helping develop the Invasion Science Research Institute at the University of Florida. He has experience researching a wide range of projects and problems on the ecology and control of insects and diseases. The work has encompassed a range of techniques and approaches from detailed studies in the laboratory through to large-scale field experiments in both temperate and tropical settings. He has published extensively (Google Scholar) but also has a strong focus on implementation and the development of practical solutions. He is an elected Fellow of the American Association for the Advancement of Science, the Entomological Society of America, and the American Society of Tropical Medicine and Hygiene.

Paul Evans

Symposium Co-chair

Research Coordinator
Invasion Science Research Institute
University of Florida

Paul is the Research Coordinator and collaborates with affiliated partners of ISRI and both internal and external boards to develop and produce necessary and exciting research. He focuses on community-based education and reporting initiatives, community ecology, and species distribution for terrestrial invasive species. He received his MSc. in Ecology and Conservation from the University of Aberdeen, and his bachelors from the University of South Florida. His aims are to bridge knowledge gaps existing in the conservation field through wildlife education, scientific research, and public engagement. Previously he worked on a team of biologists working to improve the understanding of herpetofauna and crocodilians in South Florida, the Caribbean, and endangered mammals in Central America. He has aided in improving public perception and awareness of lesser studied species in Alaska, Scotland, and is excited to continue his work in Florida. He serves as a Board member for the Florida Invasive Species Council (FISC), and is the Outreach Chair for the Everglades Cooperative Invasive Species Management Area (ECISMA). Additionally, he sits on several task teams and committees regionally including SEPARC, NECISMA, and FCISWG.

Diane Episcopio-Sturgeon

Post Doc Researcher
Invasion Science Research Institute
University of Florida

Diane is a social scientist that received her PhD in Interdisciplinary Ecology from the University of Florida in 2023. She has experience in both qualitative and quantitative social science methods and analyses, with a focus on Human Dimensions work. Her previous work has focused on Human Dimensions of the wildlife trade, with a specific look at the exotic, non-traditional pet trade. She is very excited to be a postdoctoral researcher for UF's Invasion Science Research Institute (ISRI) and explore the intersection of social and invasion science.

Yunpeng Liu

Post Doc Researcher
Invasion Science Research Institute
University of Florida

Yunpeng Liu is from China and obtained his PhD degree on Ecology at Peking University in 2021. He used to be a visiting scholar in the University of Copenhagen in Denmark during 2019-2020 and a postdoc during 2021-2023 cofounded by Peking University and the Florida Museum of Natural History in UF. He joined the Invasion Science Research Institute (ISRI) in middle 2023 as a postdoctoral researcher. He is experienced in biogeography, macroecology and biodiversity conservation. His previous works addressed the formation of plant diversity, evolution of ecological niches and the underlying drivers at large spatial and temporal scales (Google Scholar). He will integrate his knowledge on invasive science and address the interplay between invasive insects and their host plants. His future research will focus on modelling and evaluating the invasion risk of exotic species under future climate change.

Deb Stone

Doctoral Candidate for the University of Florida Forest Resources and Conservation
Extension Coordinator
Invasion Science Research Institute
University of Florida

Deb Stone is the University of Florida's Invasive Species Extension Coordinator. She has a long and dedicated history of invasive species and vegetation management here in Florida, working with many different organizations across the state- the Florida Park Service, St. Johns River Water Management District, the Nature Conservancy, Hillsborough County and Bok Tower Gardens. She is also currently a Doctoral Candidate in Forest Resources and Conservation at UF and received her master's in the same program from UF in 2017. She is particularly passionate about prioritization, decision support tools, addressing the implementation gap, and fire-invasive plant interactions.

KEYNOTE SPEAKERS

Carrie Brown-Lima

Regional Administrator
USGS Northeast
Climate Adaptation Science Center

Carrie Brown-Lima has over 25 years of experience working in the areas of natural resource conservation and management. During a career that has spanned a variety of ecosystems and multiple countries, she has developed strategic partnerships and innovative programs that integrate science into natural resource decision-making and policies. Prior to her appointment as NE CASC Regional Administrator, she served as the Director of the NY Invasive Species Research Institute at Cornell University for 9 years. In that role, she worked closely with research scientists, state and federal agencies, regional managers and other stakeholders to inform approaches to invasive species management. Brown-Lima has served as vice chair of the National Invasive Species Advisory Committee, chair of the New York State Invasive Species Advisory Committee and the North American Invasive Species Network and was an author of the New York Climate Impacts Assessment Ecosystems Chapter. She is also a co-founder of the Northeast Regional Invasive Species and Climate Change (RISCC) Management Network which won the Association of Fish and Wildlife Agencies Climate Adaptation Leadership Award for Natural Resources in 2021. From 2003-2014, Carrie worked in Brazil and throughout Latin America developing conservation strategies. Her work there included leading programs and reports to support for sustainable fisheries and agriculture and transboundary protected areas for the Rio de Janeiro State Fisheries Institute, The Nature Conservancy, ProNatura International and the Interamerican Development Bank. She holds a Bachelor of Science in Biology from Keene State College and a Master of Science in Natural Resources from Cornell University.

Wesley M. Daniel

Fishery Biologist
USGS Wetland and Aquatic Research Center

Dr. Wesley M. Daniel is a supervisory fisheries biologist with the U.S. Geological Survey at the Wetland and Aquatic Research Center in Gainesville, FL. He is the coordinator for the Nonindigenous Aquatic Species (NAS) Database and supervises a team of eight scientists and a team of student workers. Wes is an aquatic landscape ecologist, and his research focuses on identifying and modeling the impacts and introduction pathways of invasive species. Before joining USGS, Wes worked as a post-doctoral research associate for Michigan State University. He led numerous national-focused conservation projects for freshwater fishes and mussels with the National Fish Habitat Partnership, Northeast Climate Science Center, and Gulf Coast Prairie Landscape Conservation Cooperative. Wes received a M.S. in Biology from the University of Louisville and a Ph.D. in Biology from Louisiana State University.

Doria Gordon

Lead Senior Scientist & Senior Director
Environmental Defense Fund

Doria Gordon is a Lead Senior Scientist and Senior Director in the Office of the Chief Scientist at Environmental Defense Fund. Prior to EDF, she spent 25 years working in science, conservation, and management for The Nature Conservancy in Florida. Dr. Gordon is also a Courtesy Scientist in the Department of Biology at the University of Florida and a Research Associate at Archbold Biological Station. Her current research focuses on the scale and measurement of greenhouse gas mitigation in natural and agricultural systems. She also works on governance of genetically engineered organisms in agriculture and the environment, and risk assessment for invasiveness in plant species. She has also served on the boards of the Global Invasive Species Programme and Florida Exotic Pest Plant Council. Dr. Gordon completed a M.S. and Ph.D. in Ecology at the University of California at Davis following an undergraduate degree in Biology and Environmental Studies at Oberlin College.

Pam Marrone

Co-founder and Executive Chair
Invasive Species Corporation

Dr. Marrone spent her 30+ year career focused on biological products for pest management and plant health, having started and led three bioag companies (Entotech, AgraQuest and Marrone Bio Innovations (now called Profarm Group), all of which were sold to larger companies. She is one of only 32 women to have founded a company and taken it public (MBII:NASDAQ). With co-founder Jim Boyd, the former CFO of Marrone Bio, Pam has launched a fourth company, the Invasive Species Corporation, to bring effective, environmentally friendly biological solutions to control destructive invasive species, in water, forestry and agriculture. She is on the board of the Foundation for Food and Agricultural Research, is a Senior Fellow of the Arizona State University Swette Center for Sustainable Food Systems and is a past alumni-Trustee of Cornell University. She is Chair of the Board of Elicit Plant and serves on the boards of 180 Life Sciences (NASDAQ:ATNF), Stem Express and Pheronym and advises several agtech/agbio startups, many founded or led by women. Among her many awards, in 2023 she received the Rosalind Franklin Award from the Biotechnology Industry Organization and in 2022 she was the first woman to receive the American Chemical Society “Kathryn C. Hach Award for Entrepreneurial Success.” She has a B.S. in entomology with Honors and Distinction from Cornell University and a Ph.D. in entomology from North Carolina State University. She is a Fellow of the AAAS and has over 400 patents.

Daniel Simberloff

Nancy Gore Hunger Professor of Environmental Studies
Department of Ecology and Evolutionary Biology
University of Tennessee

Daniel Simberloff received his A.B. (1964) and Ph.D. (1968) from Harvard University and was a faculty member at Florida State University from 1968 through 1997, when he moved to the University of Tennessee. His publications number ca. 500 and center on ecology, biogeography, evolution, and conservation biology; much of his research focuses on causes, consequences, and management of biological invasions. His research projects are on insects, plants, fungi, birds, and mammals. He is co-editor-in-chief of Biological Invasions, senior editor of the Encyclopedia of Biological Invasions (2012), author of Invasive Species: What Everyone Needs to Know (2013), co-editor of Integrating Biological Control into Conservation Practice (2016), and co-editor of the annotated 2nd edition of Charles Elton's The Ecology of Invasions by Animals and Plants (2020). In 2006 he was named Eminent Ecologist by the Ecological Society of America, in 2012 he won the Margalef Prize for research in ecology, and in 2015 he won the Wallace Prize of the International Biogeography Society for lifetime contributions. He is a member of the U.S. National Academy of Sciences and the American Academy of Arts and Sciences.

Trevor Smith

State Plant Regulatory Official & Division Director
FDACS Division of Plant Industry

Dr. Trevor Smith is the Director of the Division of Plant Industry (DPI), one of the largest and most technical divisions within the Florida Department of Agriculture and Consumer Services (FDACS). Dr. Smith began his career with the Florida Department of Agriculture and Consumer Services in 2006 as a Laboratory Technician in Gainesville while working on his Ph.D. He subsequently held positions as the State Survey Coordinator for the Florida Cooperative Agricultural Pest Survey program and Chief of the Bureau of Methods Development and Biological Control. Dr. Smith is also a courtesy Professor with the Entomology and Nematology Department and graduate faculty at the University of Florida. As the Director of the Division of Plant Industry, he is responsible for almost 700 employees in 54 offices from Pensacola to Florida City working to protect Florida's agriculture and natural resources from exotic plant and honeybee pests and diseases. He is also the State Plant Regulatory Official (SPRO) for Florida and represents the state on pest and disease issues nationally and internationally. He has a Ph.D. and M.S. in entomology and nematology from the University of Florida and a B.S. in biology from the University of Central Florida. During his tenure with the Department, Dr. Smith has authored and co-authored dozens of publications on invasive species, including, but not limited to, scale insects, whiteflies, stinkbugs, lygus bugs, tephritid fruit flies, the rat lungworm, and invasive land snails. He has worked on and led many major eradication campaigns, such as the cotton seed bug, lime swallowtail, giant African land snail, various Mediterranean fruit fly, and Oriental fruit fly, as well as numerous early detection and rapid-response programs. He also managed numerous successful biological control programs, including tropical soda apple, air potato vine, pink hibiscus mealybug, imported fire ant, cactus moth, Asian citrus psyllid, diaprepes root weevil, Caribbean fruit fly, and various other significant pests and weed control efforts.

AGENDA-AT-A-GLANCE

MONDAY, MAY 6, 2024	
5:00pm-7:00pm	**Informal Networking Social at Piesanos Stone Fired Pizza** After checking into your hotel, stop by and connect with colleagues before the symposium begins! Address: Located in the Holiday Inn University Center 1250 W University Ave, Gainesville, FL 32601
TUESDAY, MAY 7, 2024	
Meeting Location: All sessions will be held in the J. Wayne Reitz Union on the UF campus. Address: University of Florida, 655 Reitz Union Drive, Gainesville, FL 32603	
8:00am-9:00am	**Registration Open**
8:00am-9:00am	**Morning Coffee & Tea Services Provided *(Breakfast on Own)*** (Reitz Union Grand Ballroom - 2nd Floor)
8:00am-3:15pm	**Poster Presenter Display Setup**
9:00am-5:00pm	**General Session** (Reitz Union Grand Ballroom – 2nd Floor)
12:30pm-1:30pm	**Group Luncheon** (Reitz Union Grand Ballroom - 2nd Floor)
5:00pm-7:00pm	**Poster Session & Networking Reception** (Reitz Union Grand Ballroom - 2nd Floor)
WEDNESDAY, MAY 8, 2024	
8:00am-9:00am	**Registration Open**
8:00am-9:00am	**Morning Coffee & Tea Services Provided *(Breakfast on Own)*** (Reitz Union Grand Ballroom - 2nd Floor)
9:00am-5:00pm	**General Session** (Reitz Union Grand Ballroom – 2nd Floor)
12:35pm-1:30pm	**Group Luncheon** (Reitz Union Grand Ballroom - 2nd Floor)
3:00pm-3:30pm	**Poster Presenter Display Breakdown**
5:00pm-7:00pm	**The Big Finale with Fun, Games & A Networking Social** (Reitz Union Game Room – Ground Floor)

DETAILED AGENDA

MONDAY, MAY 6, 2024	
5:00pm-7:00pm	**Informal Networking Social at Piesanos Stone Fired Pizza** [After checking into your hotel, stop by and connect with colleagues before the symposium begins!]
TUESDAY, MAY 7, 2024	
8:00am-9:00am	Registration Open
8:00am-9:00am	**Morning Coffee and Tea Service Provided (Breakfast on Own)**
8:00am-3:15pm	Poster Presenter Display Set Up
9:00am-5:00pm	**General Session**
9:00am-9:15am	Welcome Remarks
9:15am-10:30am	**Session 1: Understanding Pathways of Introduction** Moderator: **Matthew B. Thomas**, Invasion Science Research Institute
9:15am	**Keynote Speaker - Trevor Smith**, FDACS Division of Plant Industry Non-traditional Pathways: Rethinking How Invasive Species Move Around the World
9:45am	**Lawrence Lopez**, Florida International University Invasion Pathways: The Spread of the New Guinea Flatworm to Outlying Conservation Lands of South Florida
10:00am	**Aaron I. Plex Sulá**, University of Florida | Proactive Biosecurity Priorities Revealed by the Global Biogeography of 1000 Plant Pathogens
10:15am	**Yunpeng Liu**, University of Florida Ensemble Modeling of Invasion Risk Under Future Climate and Land Use Change
10:30am-11:00am	**Morning Break and Networking**

PRESENTATION NOTES

Speaker Name / Notes

TUESDAY, MAY 7, 2024 *(continued)*	
11:00am-12:30pm	**Session 2: Determinants of Establishment - Part 1** Moderator: **Deb Stone**, Invasion Science Research Institute & University of Florida Forest Resources and Conservation
11:00am	**Keynote Speaker - Wesley M. Daniel**, USGS Wetland and Aquatic Research Center Charting Invasion Pathways: Navigating the Dynamics of Intrusion
11:30am	**Christopher Searcy**, University of Miami Traits that Facilitate Invasion of Native Habitat
11:45am	**Elena Tartaglia**, The State University of New Jersey Is There Evidence for the Ubiquitous Use of Non-Native Plants Over Natives in Urban Horticulture?
12:00pm	**Srikantnag Angondalli Nagaraja**, University of Florida Combating Biodiversity Threats: Machine Learning and Satellite Remote Sensing in Tracking *Opuntia stricta* in Laikipia County, Kenya
12:15pm	**Michael McCoy**, Florida Atlantic University The Comparative Functional Response Approach: Linking Application to Ecological Theory
12:30pm-1:30pm	**Group Luncheon**

PRESENTATION NOTES

Speaker Name / Notes

TUESDAY, MAY 7, 2024 *(continued)*	
1:30pm-2:45pm	**Session 3: Determinants of Establishment - Part 2** Moderator: Diane Episcopi-Sturgeon, Invasion Science Research Institute
1:30pm	**Keynote Speaker - Carrie Brown-Lima**, USGS Northeast Climate Adaptation Science Center Bridging Research and Practice to Address Invasive Species in a Changing Climate
2:00pm	**Joel Trexler**, Florida State University Impacts Following Boom-and-Bust Invasion Dynamics: African Jewelfish in the Shark River Slough
2:15pm	**Aruni Kadawatha**, Case Western Reserve University Impacts of Global Warming on Seed Germination and the Influence of Differential Land Uses on the Occurrence of Invasive *Rosa multiflora* and Native *Rosa setigera* in Cuyahoga County, Ohio
2:30pm	**Seokmin Kim**, University of Miami Non-Native Mammals Negatively Affect Native Frugivory in the Eastern Caribbean
2:45pm-3:15pm	**Afternoon Break and Networking**

PRESENTATION NOTES

Speaker Name / Notes

TUESDAY, MAY 7, 2024 *(continued)*	
3:15pm-5:00pm	**Session 4: Special Session - Herpetofauna in Florida** Moderator: **Paul Evans**, Invasion Science Research Institute
3:15pm	**Melissa Miller**, University of Florida Linking Burmese Python Ecology with Removal Efforts in the Everglades
3:30pm	**Kevin Donmoyer**, National Park Service A Summary of Tegu Control in Everglades National Park
3:45pm	**McKayla Spencer**, Florida Fish and Wildlife Conservation Commission Florida Python Control Plan: Creation and Implementation
4:00pm	**Kate Davis**, University of Florida Determining the Origin of Migrating Birds Consumed by Burmese Pythons While Overwintering in Florida
4:15pm	**Madison Harman**, University of Florida Analysis of Invasive Tegu Diet Composition in Two Florida Populations
4:30pm	**Christina Romagosa**, University of Florida Prey Species Composition, Richness, and Diversity of Burmese Python Diet in Florida
4:45pm	**Nathan Burkett-Cadena**, University of Florida Invasive Reptile-Mediated Risk of Mosquito-Borne Pathogen Transmission
5:00pm-7:00pm	**Poster Session & Networking Reception**

PRESENTATION NOTES

Speaker Name / Notes

WEDNESDAY, MAY 8, 2024	
8:00am-9:00am	Registration Open
8:00am-9:00am	**Morning Coffee and Tea Service Provided (Breakfast on Own)**
9:00am-5:00pm	**General Session**
9:00am-10:30am	**Session 5: Ecological, Economic, and Societal Impacts - Part 1** Moderator: **Matthew B. Thomas**, Invasion Science Research Institute
9:00am	**Keynote Speaker - Daniel Simberloff**, University of Tennessee Can New Technologies Really Turn the Tide?
9:30am	**Brittany Harris**, Florida International University Integrating Pairwise and Community Observations to Evaluate Pollinator Invasions
9:45am	**Christopher Lepczyk**, Auburn University A Global Synthesis and Assessment of Free-Ranging Domestic Cat Diet
10:00am	**John Andrew Nyman**, Louisiana State University (Some) Success Controlling Ecosystem Damage Caused by Nutria and Hogs in Louisiana's 14,000 km2 of Coastal Wetlands
10:15am	**Ashish Adhikari**, University of Florida R2M Toolbox for Rapid Risk Assessment Supporting Mitigation of Invasive Pathogens and Pests: Perspectives on Rice Health in Nepal
10:30am-11:00am	**Morning Break and Networking**

PRESENTATION NOTES

Speaker Name / Notes

WEDNESDAY, MAY 8, 2024 *(continued)*	
11:00am-12:30pm	**Session 6: Ecological, Economic, and Societal Impacts - Part 2** Moderator: **Diane Episcopio-Sturgeon**, Invasion Science Research Institute
11:00am	**Paul Evans**, Invasion Science Research Institute Introduction to the Leftovers Initiative: Identifying Gaps in Invasion Ecology
11:15am	**Steve Hovick**, Ohio State University Nonlinearities in Assisted Succession to Suppress Reed Canarygrass: A 16-Year Restoration Experiment
11:30am	**Zachary Steele**, Old Dominion University Integrating Social Science and Stable Isotope Analysis with Non-native Game Species Management
11:45pm	**Erica Goss**, University of Florida Plant Invasions Promote Plant Pathogen Emergence
12:00pm	**Benjamin Reimer**, University of Florida Changes in Soil Microbial Diversity and Community Composition Across a Pine Invasion Gradient
12:15pm	**Brooks Parrish**, University of Florida Curtailing Invasive Species in Gardens through Genetic Sterilization and Genomic Research
12:30pm	**Robert Gilbert**, Interim SVP, Dean for Research and Director, Office of Dean for Research and the UF/IFAS FL Agricultural Experiment Station Welcome to the University of Florida
12:35pm-1:30pm	**Group Luncheon**

PRESENTATION NOTES

Speaker Name / Notes

WEDNESDAY, MAY 8, 2024 *(continued)*	
1:30pm-3:00pm	**Session 7: Translation of Knowledge into Improved Strategies - Part 1** Moderator: **Deb Stone**, Invasion Science Research Institute & University of Florida Forest Resources and Conservation
1:30pm	**Keynote Speaker - Pam Marrone**, Invasive Species Corporation Status and Potential of Biologicals for Invasive Species Management
2:00pm	**Yuanming Lu**, University of Florida Optimizing Biocontrol in Invasive Species: Agent-Based Model Insights
2:15pm	**Diane Sturgeon**, University of Florida Exploring Non-Traditional Pet Owners' Attachment to Their Pets Using the Lexington Attachment to Pets Scale (LAPS)
2:45pm	**Luke Evans**, University of Florida An Integrative Approach for Robust Invasive Species Risk Assessments
3:00pm-3:30pm	**Afternoon Break and Networking**
3:00pm-3:30pm	**Poster Presenter Display Breakdown**

PRESENTATION NOTES

Speaker Name / Notes

WEDNESDAY, MAY 8, 2024 *(continued)*	
3:30pm-5:00pm	**Session 8: Translation of Knowledge into Improved Strategies - Part 2** Moderator: **Paul Evans**, Invasion Science Research Institute
3:30pm	**Keynote Speaker - Doria Gordon**, Environmental Defense Fund Genetically Engineered Organisms: Invasion Solution or New Risk?
4:00pm	**Chuck Bargeron**, University of Georgia Thinking Differently about Early Detection and Rapid Response and Invasive Species Outreach
4:15pm	**Nicole Hernandez**, U.S. Geological Survey Improving Early Detection and Rapid Response Efforts through Collaboration and Information Sharing
4:30pm	**Wesley Daniel**, University of California Don't Move a Mussel: Targeting to Prevent Dreissenid Spread in the Missouri River Basin
4:45pm	Brief Closing Remarks
5:00pm-7:00pm	**The Big Finale with Fun, Games, and a Networking Social** (Reitz Union Game Room - Ground Floor)

PRESENTATION NOTES

Speaker Name / Notes

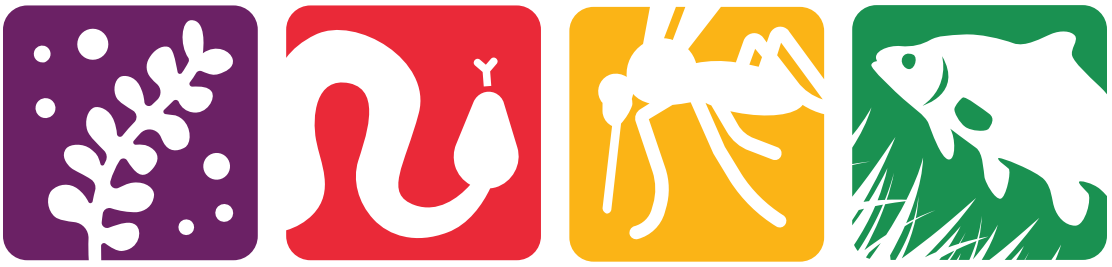
POSTER INFORMATION

Poster presentations play a key role in the exchange of information. Considerable time will be dedicated for viewing them, and posters will be on display throughout the symposium in the Poster Hall. This is the primary gathering spot where morning coffee, lunch, mid-day and afternoon breaks are served, as well as a formal poster session. This allows plenty of time for visibility, networking and interaction with fellow presenters and attendees.

Poster Room Schedule

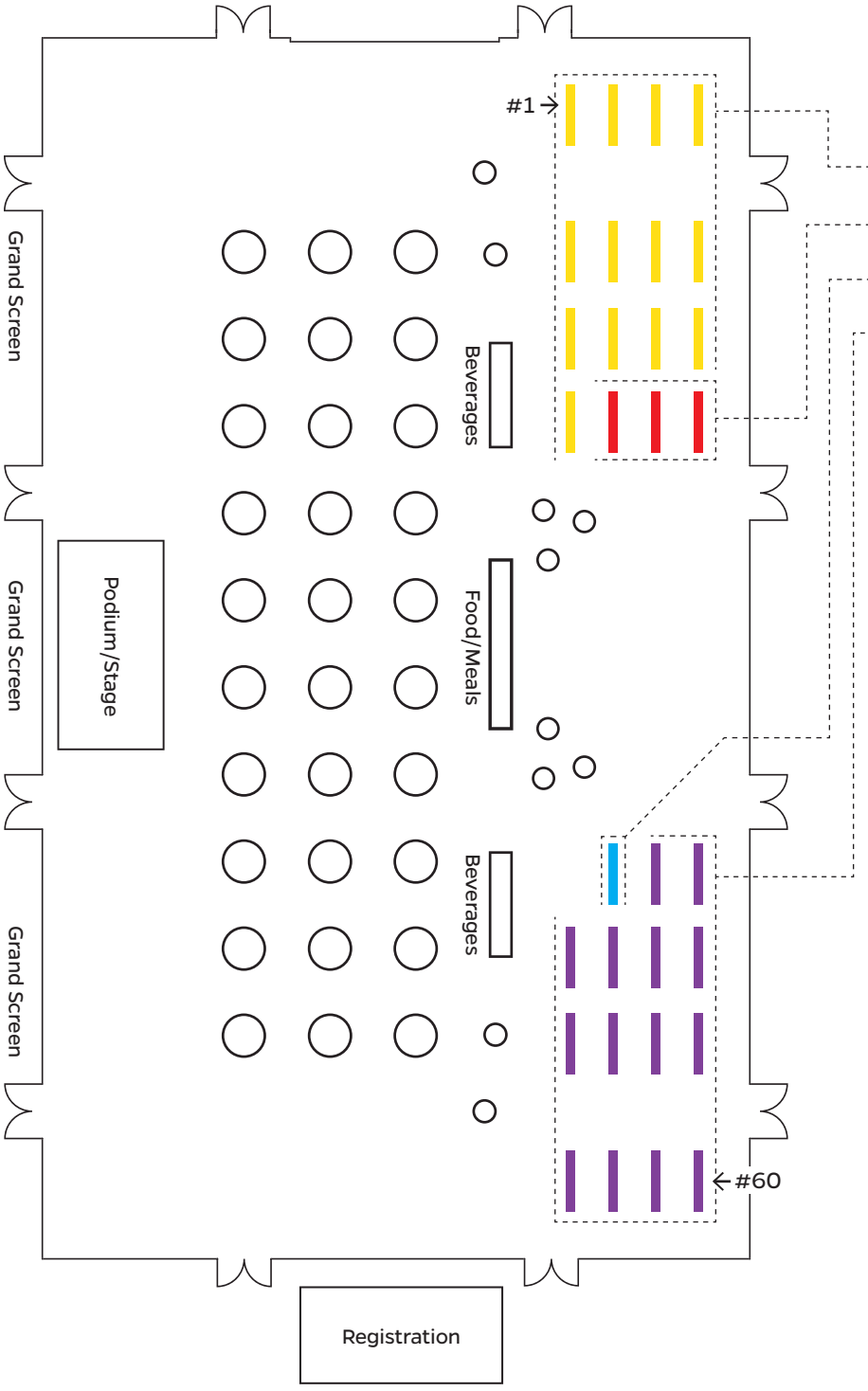
Poster Set Up:	**Tuesday, May 7, 2024 | 8:00am–3:15pm** **All posters are on display throughout the symposium.*
Formal Poster Session:	**Tuesday, May 7, 2024 | 5:00pm-7:00pm** **Presenters are advise to be at their board from 6:00pm-7:00pm.*
Poster Removal:	**Wednesday, May 8, 2024 | 3:00pm-3:30pm**

*The poster board vendor will remove the boards on Wednesday, May 8, before The Big Finale. Take your poster before 3:30pm that day. ***Organizers are not responsible for discarded posters.***



POSTER ROOM LAYOUT

Grand Ballroom | 2nd Floor | J. Wayne Reitz Union



POSTERS BY NUMBER GROUPS

- Posters 1-25
- Posters 26-31
- Posters 32-33
- Posters 33-60

POSTERS BY THEME

- Translation of Knowledge into Improved Strategies (Posters 1-25)
- Determinants of Establishment (Posters 26-31)
- Understanding Pathways of Introduction (Posters 32-33)
- Ecological, Economic, and Societal Impacts (Posters 34-60)

POSTER DIRECTORY

Posters are listed by theme in order of poster number, then by presenter last name.

Translation of Knowledge into Improved Strategies						
First	Last	Organization	City	ST	Abstract Title	#
Shirley	Baker	University of Florida	Gainesville	FL	Bulimulus spp. Interdisciplinary Working Group: Managing an Invasive Snail in the SE and Gulf States	1
Caitlin	Beaver	U.S. Geological Survey	Gainesville	FL	Using environmental DNA to assess the northern geographic extent of Burmese pythons in Florida	2
Mary	Brown	U.S. Geological Survey	Gainesville	FL	Fish Slam: Eleven Years of Collaborative Non-native Fish Monitoring	4
Morgana	De Souza Miranda	University of Florida	Gainesville	FL	Pesticidal Proteins Toxic to the Asian Citrus Psyllid, an Invasive Pest in Citrus	5
Berea	Etherton	University of Florida	Gainesville	FL	GeoPathome: An Interactive Web-Scraping Tool for Global Pest and Pathogen Risk Analysis	6
Seth	Farris	United States Department of Agriculture	Davie	FL	Refining Integrated Pest Management for Waterhyacinth (Pontederia crassipes) in Lake Okeechobee	7
Alex	Furst	University of Florida	Gainesville	FL	Assessment and Surveillance of Argentine Black and White Tegu Abundance in Charlotte County, FL, USA	8
Daniel	Haro	University of Florida	Gainesville	FL	Using Removal Data to Estimate Abundance of Invasive Species to Inform Management Decisions	9
Yoosook	Lee	University of Florida	Vero Beach	FL	International BEACONS IPM Working Group	10
Storm	Miller	University of Florida	Gainesville	FL	Integrating AI and Camera Traps to Detect Invasive Pythons	11
Romaric Armel	Mouafo Tchinda	University of Florida	Gainesville	FL	Laurel Wilt Threatens Global Forests: Designing Surveillance and Mitigation Strategies	12

Translation of Knowledge into Improved Strategies (continued)						
First	Last	Organization	City	ST	Abstract Title	#
Valerie	Nguyen	University of Florida	Melbourne	FL	IPM WORKING GROUP: Mosquito Beacons- Biodiversity Enhancement and Control of Non-Native Species - 2024 Update	**13**
Morgan	Pinkerton	UF/IFAS Extension Seminole County	Sanford	FL	Extension Webinars Training First Detectors on Early Detection & Identification of Invasive Species	**14**
Carrie	Reinhardt Adams	University of Florida	Gainesville	FL	A retrospective analysis of research on plant-invaded wetlands: Science and practice for restoration	**15**
Amber	Riner	University of Florida	Gainesville	FL	RGB Vegetation Indices for Remotely Monitoring Herbicide Injury in Water Hyacinth	**16**
Amber	Riner	University of Florida	Gainesville	FL	Developing Aerial Surveillance Methods for Identifying Water Hyacinth on Lake Lochloosa in Florida	**17**
Mark	Sandfoss	U.S. Geological Survey	Homestead	FL	Spatial Ecology of Juvenile Burmese Pythons in Big Cypress National Preserve, FL, USA	**18**
Michael	Sipos	UF/IFAS Extension Collier County	Naples	FL	Using Anglers to Remove Invasive Species, A Summary of the SWFL CISMA Invasive Fish Roundup	**19**
Shelby	Stanley	Florida Fish & Wildlife Conservation Commission	Sunrise	FL	Not so Black & White: Adapting Strategies to Improve Tegu Trapping Efficacy	**20**
Kathryn	Temple	Auburn Univeristy	Auburn	AL	Evaluating the Effectiveness of Baited-Ink Plates for Rat Monitoring in a Montane Rainforest	**21**
Eric	Tillman	United States Department of Agriculture	Gainesville	FL	A Novel Parakeet-Selective Feeder for Control of Invasive Psittacines	**22**
Linhao	Xu	University of Miami	Miami	FL	Spatial Patterns as Long Transients in Submersed-Floating Plant Competition with Biocontrol	**23**
Wesley	Daniel	USGS Wetland and Aquatic Research Center	Gainesville	FL	Southeast Regional Invasive Species and Climate Change Management Network (SE RISCC)	**24**
Paul	Evans	University of Florida	Gainesville	FL	Advancements in Invasive Snake Lung Pentastomes Surveillance Efforts	**25**

Determinants of Establishment						
First	**Last**	**Organization**	**City**	**ST**	**Abstract Title**	**#**
S. Luke	Flory	University of Florida	Gainesville	FL	Urban Evolved Invasive Plant Tolerates Experimental Climate Change	**26**
Heidi	Himes	U.S. Fish and Wildlife Service	Basom	NY	Incorporating Climate Change into Risk Screening	**27**
Jason	Martina	Texas State University	San Marcos	TX	The Role of Propagule Pressure, Biotic Resistance, and Nitrogen Loading on Wetland Invasion Dynamics	**28**
Jacobo	Robledo	University of Florida	Gainesville	FL	Invasive Pathogen Threatens Colombian Bananas: Role of Host Connectivity, Trade, and Human Movement	**29**
Sangwoo	Seok	University of Florida	Vero Beach	FL	Investigation of the Genetic Structure and the Insecticide Resistance of Invasive Aedes mosquitoes in Hawaii	**30**
Benjamin	Share	Nova Southeastern University	Dania Beach	FL	Comparing Hypoxia Tolerance of Native and Invasive Everglades Fishes in Climate Change Scenarios	**31**

Understanding Pathways of Introduction						
First	**Last**	**Organization**	**City**	**ST**	**Abstract Title**	**#**
Andrew	Furness	Florida Museum of Natural History	Gainesville	FL	Nonindigenous Fishes in the Fresh Waters of Florida	**32**
Richard	McCoy	University of Florida	Gainesville	FL	Scenario Analysis for Invasive Species Management: An App for Evaluating Social-Ecological Networks	**33**

Ecological, Economic, and Societal Impacts						
First	**Last**	**Organization**	**City**	**ST**	**Abstract Title**	**#**
Marina	Ascunce	United States Department of Agriculture	Gainesville	FL	Genetic Diversity and Climatic Variables Along Two Latitudinal Clines in an Invasive Ant	**34**
Felipe	Barreto da Silva	University of Florida	Riverview	FL	Diversity and Integrated Management Approaches of Megalurothrips usitatus, an Invasive Thrips Threatening Legume Production in South Florida and Central America	**35**

Ecological, Economic, and Societal Impacts (continued)						
First	**Last**	**Organization**	**City**	**ST**	**Abstract Title**	**#**
Campbell	Bonner	University of Tampa	Tampa	FL	Disruption or Replacement? The Role of the Invasive Brazilian Peppertree in Coastal Nutrient Cycling	**36**
Simon	Casas	University of Florida	Vero Beach	FL	Influence of Temperature on the Biting Persistence of Aedes aegypti, a Key Invasive Vector in Florida	**37**
Natalie	Claunch	United States Department of Agriculture	Gainesville	FL	Impacts of Green Iguana to Property, Infrastructure, and Safety in Florida	**38**
Ally	Cobern	Auburn University	Auburn	AL	A Global Analysis of the Impacts of Free-ranging Dogs on Native Wildlife	**39**
Nathan	Dorn	Florida International University	North Miami	FL	Predation by Invasive Asian Swamp Eels Reducing Populations of Common Fishes and Decapods in the Florida Everglades	**40**
Clebson	Dos Santos Tavares	University of Florida	Gainesville	FL	Bacillus thuringiensis-derived Pesticidal Proteins Toxic to the Whitefly, an Invasive Agricultural Pest	**41**
Jean	Fantle-Lepczyk	Auburn University	Auburn	AL	Identifying Cost-Efficient Management Options for the Critically Endangered Puaiohi, (Myadestes Palmeri)	**42**
Danielle	Ganas	Florida Fish and Wildlife Conservation Commission	Lake City	FL	Crayfish Barrier Construction to Conserve Imperiled Black Creek Crayfish	**43**
Sankara	Ganesh	University of Florida	Lake Alfred	FL	Evaluating Spatial Distribution, Trapping, and Potential Chemical Control of the Invasive Land Snail Bulimulus bonariensis in Citrus	**44**
Brandon	Güell	Florida International University	Miami	FL	Does Invasion History Affect Recognition and Responses of Native Crayfish to the Invasive Swamp Eel?	**45**
Madison	Harman	University of Florida	Gainesville	FL	Spatial Analysis of Invasive Pentastomes Infecting Two Populations of Invasive Argentine Giant Tegus in Florida	**46**
Kodiak	Hengstebeck	University of Florida	Gainesville	FL	Investigating the Potential for Morphological Change in Invasive Snakes	**47**
Alyssa	Herrera	Florida International University	Miami Springs	FL	Asian Swamp Eel Prey Use in the Everglades Depends on Invasion History	**48**

Ecological, Economic, and Societal Impacts (continued)						
First	**Last**	**Organization**	**City**	**ST**	**Abstract Title**	**#**
Christine	Romagosa	University of Florida	Gainesville	FL	Impact of the Invasive Burmese Python on the Everglades Food Web	**50**
Ayesha	Malligai M	University of Florida	Plant City	FL	Enhancing Hydrilla Monitoring in Aquatic Ecosystems: A Comparative Analysis of Atmospheric Correction Algorithms on Sentinel-2 Satellite Data	**51**
Yasmin	Ortiz	University of Florida	Vero Beach	FL	Characterizing Mosquito and Host Communities in Residential and Conservation Areas to Inform Invasive Species Distribution in Florida	**52**
Jessica	Rieder	U.S. Geological Survey	Gainesville	FL	Exploring the Feasibility of Genetic Biocontrol Applications for the Invasive Burmese Python in the Greater Everglades of Florida	**53**
Abhishek	Rajan	University of Florida	Gainesville	FL	Confronting Aquatic Invaders: Assessing Public Perceptions and Willingness to Pay to Control Hydrilla in Florida	**54**
David	Santamaria	Florida International University	Miami	FL	Changing Human Perceptions of Introduced Hippos in Colombia, 2017-2023	**55**
Sara	Bolds	University of Florida	Gainesville	FL	Response of an imperiled endemic Florida crayfish *(Procambarus pictus)* to an invasive congener *(Procambarus spiculifer)*	**56**
Carlos	Tapia	Florida International University	Miami	FL	Flora Unchecked: Investigating the Consequences of Ornamental Plant Invasions	**57**
Lori	Tolley-Jordan	Jacksonville State University	Jacksonville	AL	What to Expect When You're Expecting the Invasion of the Freshwater Assassin Snail, *Anentome helena*	**58**
Zahra	Torkaman	University of Florida	Lake Alfred	FL	Phenology and Spatial Distribution of the Invasive Species, Scirtothrips dorsalis Hood (Thysanoptera: Thripidae) in Florida Citrus Screenhouse Production Systems	**59**
Briana	Zaffiro	Nova Southeastern University	Davie	FL	Comparative Study Between the Helminth Endoparasite Community of Columbids in South Florida, USA, and Eleuthera, Bahamas	**60**

INVASION SCIENCE RESEARCH SYMPOSIUM

ABSTRACT COMPILATION

Abstracts are listed in alphabetical order by **presenter last name.**

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R2M Toolbox for Rapid Risk Assessment Supporting Mitigation of Invasive Pathogens and Pests: Perspectives on rice health in Nepal

Ashish Adhikari[1,2,3], *Berea A. Etherton*[1,2,3], *Katelin Alcock*[1,2,3], *Robert Fontan*[1,2,3], *Theodore J. Stronkowsky*[1,2,3], *Romaric A. Mouafo-Tchinda*[1,2,3], *Aaron I. Plex Sula*[1,2,3], *and Karen A. Garrett*[1,2,3]

[1]Plant Pathology Department, University of Florida, Gainesville, FL, USA
[2]Global Food Systems Institute, University of Florida, Gainesville, FL USA
[3]Emerging Pathogens Institute, University of Florida, Gainesville, FL USA

The emergence of crop pathogens and pests threatens global food security. Here we introduce a new computational toolbox, R2M, designed to address the critical challenges of plant health management. R2M offers a comprehensive open-source ecosystem providing stakeholders and decision makers with tools to understand, predict and mitigate the risks associated with plant pathogens and pests. R2M includes (a) expert knowledge elicitation (EKE), (b) habitat or cropland connectivity analysis, (c) trade network analysis, including GeoPathome, and (d) impact network analysis (INA) for scenario analysis of regional analysis. We used the R2M toolbox to evaluate health risks to rice in Nepal. Rice accounts for approximately 40% of the country's caloric intake (Neupane et al. 2021), contributing 51.6% of the total grain production (MOAD 2017). Protecting rice production depends on limiting the spread of crop pathogens and pests. Our objectives were to evaluate rice cropland connectivity (CC) and trade networks to understand the potential spread of pathogens and pests in Nepal and the surrounding region, and to identify key locations in invasions. Incorporating CC risk with other risk factors for pathogen buildup can improve methods for detecting and mitigating the spread of current and emerging pathogens. Based on CC analysis, we identified high-risk areas that are candidate priorities for risk mitigation procedures. Trade network analysis addresses how the movement of goods can contribute to the spread of pathogens. We evaluated trade networks in terms of the potential movement of multiple pathogens, including *Magnaporthe oryzae* and *Ustilaginoidea virens*, to identify highly connected countries with the potential for pathogen movement if there are not sufficient phytosanitary controls in place. These analyses can help guide prioritization for rice health management, and are a baseline for new collaborations between UF, IRRI and Nepali scientists.

Combating Biodiversity Threats: Machine Learning and Satellite Remote Sensing in Tracking *Opuntia stricta* in Laikipia County, Kenya

***Srikantnag A. Nagaraja**, Kenneth T. Oduor, Dinesh C. Gogineni, Igor L. Bretas, Jose Dubeux, Chang Zhao*
University of Florida, Gainesville, FL, *USA*

The invasion of *Opuntia stricta* in Laikipia County, Kenya presents a critical threat to biodiversity, affecting native ecosystems, wildlife, and livestock. Addressing this challenge requires innovative solutions beyond traditional management practices. Our study introduces a novel approach utilizing satellite remote sensing and machine learning to effectively map and monitor the spread of *Opuntia stricta at large scales*. We leveraged Sentinel-2 satellite imagery and extracted key time-series vegetation indices, including NDVI, GNDVI, EVI, NDWI, and MSAVI2, for spatial prediction of *Opuntia stricta* at 10-meter resolution. Terrain, climate, landscape, and sociodemographic data were integrated to enhance predictive capabilities. A significant challenge faced was the absence of ground truth data for *Opuntia stricta*. We addressed this by creating annotated datasets through ground surveys and satellite image interpretations, resulting in 6242 labeled pixels covering various land cover classes. We employed multiple supervised machine-learning models, including Random Forest, Ada Boost, XG Boost, MLP, and RBF-SVM, for both multiclass and binary classification of land cover. These models were rigorously evaluated, yielding testing accuracies of approximately 85% for multiclass and 90% for binary classification. Our study not only provides a comprehensive mapping and monitoring framework for *Opuntia stricta,* but also contributes significantly to the effective management and conservation efforts in Laikipia County. It demonstrates the potential of integrating moderate-resolution satellite remote sensing and machine learning in addressing invasive species challenges at large scales, setting a precedent for similar ecological problems worldwide.

Is There Evidence for the Ubiquitous Use of Non-native Plants Over Natives in Urban Horticulture?

*Elena S. Tartaglia and **Myla F.J. Aronson***
Department of Ecology, Evolution and Natural Resources, Rutgers, The State University of New Jersey, New Brunswick, New Jersey, USA

Although the flora of the world's cities is primarily native, most plant species utilized for urban horticulture are not. Despite ample evidence that some non-native plants become invasive and that most introductions of invasive plants occur via the horticultural trade, non-native plants continue to dominate the horticultural industry. Decisions that prioritize non-native plantings in urban habitats are driven by a variety of factors including: the history of the nursery trade, European design dominating landscape architecture, as well as perceptions that non-native plants are better adapted to urban habitats and more aesthetically pleasing. However, little research has empirically compared native and non-native plants in urban horticulture. Here, we performed a systematic literature review to ask the following questions: 1) Are there differences between native and non-native plants in their ability to support higher trophic levels, 2) Are there differences between native and non-native plants in their ability to provide urban ecosystem services? and 3) Do non-native plants have better fitness and growth than natives in urban habitats? We found overwhelming evidence that native plants support greater community diversity and populations of native birds and lepidoptera than non-native plants and mixed evidence for bees. Native plant species outperformed non-natives in the provisioning of biodiversity and human health and well-being. However, non-native species assemblages often lead to greater carbon stocks and sequestration, likely because they are found in highly irrigated habitats (i.e., lawns). Although there is relatively little research comparing native and non-native plant fitness and growth in urban horticulture, there is no evidence that native plants are outperformed by non-native ornamentals. More research, planning and policies, as well as collaborations with nursery and design professionals that prioritize native species in urban horticulture is urgently needed.

Genetic Diversity and Climatic Variables Along Two Latitudinal Clines in an Invasive Ant

Marina S. Ascunce[1]*, Quentin D. Reed*[2]*, Douglas B. Booher*[3] *and Robert Guralnick*[4]

[1]USDA-ARS-CMAVE, Fire Ant Unit, Gainesville, FL, USA
[2]USDA-ARS, Southeast Area, Raleigh, NC, USA
[3]USDA, Forest Services, Athens, GA, USA
[4]University of Florida, Gainesville, FL, USA

Invasive species often show evidence of rapid adaptation in response to climatic changes. In this study we focus on climate adaptation in the highly invasive Red Imported Fire ant, *Solenopsis invicta*, by sampling populations in the U.S. (invasive range) and Argentina (native range) following a latitudinal transect in each area. This invasive species has been expanding its geographic range to higher latitudes in the U.S. since its introduction approximately 80 years ago. Human-mediated trade and transportation are thought to be the major forces behind its spread whereas temperature and precipitation have been considered its main limitations. However, *S. invicta* is already occupying regions that were predicted to be reached in 2080. To understand its current distribution and predict future expansions, it is important to understand its rapid adaptation. In this study, we analyzed the genetic profiles of 20 nests from U.S. and 20 from South America (native range) using a set of 59 microsatellite loci to test the classical Isolation by distance (IBD) model. These analyses showed that genetic divergence tends to increase with geographical distance among populations in both geographic ranges. A global analysis for outlier detection using BayeScan indicated some outlier loci that were mapped in the reference genome and will be assessed as candidate genes that could be under selection. A set of statistical analysis was performed including climate variables and their relationship to genetic diversity. There was a positive relationship showing higher expected heterozygosity at higher latitudes in both ranges. Overall, the relationships between temperature and genetic diversity estimators are more positive in the U.S. than in Argentina (positive interaction coefficient, $p = 0.03$) suggesting that selection may be stronger in the higher latitude locations in the U.S. Future studies including whole genome sequencing will deepen our understanding on the climate adaptation in this invasive ant.

A Framework for Knowledge Co-production Using Novel Interactive Expert-elicitation Software

J Alex Baecher[1]*, Luke Evans*[2]*, Joshua A Cullen*[3]*, Christina M Romagosa*[2]*, Wesley M Daniel*[4]*, Blake Blaskowski*[4]*, and Brett R Scheffers*[2]

[1]School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA
[2]Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA
[3]U.S. Geological Survey, Eastern Ecological Science Center, Kearneysville, WV, USA
[4]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, Florida, USA

Knowledge gaps between academic research and on-the-ground practitioners pose a major limitation to invasive species management. Evaluations of species' impacts and potential for spread often focus on isolated academic studies, ignoring the wealth of information held by expert practitioners, such as managers and stake-holders. This issue is especially apparent in the Southeastern US, where an ongoing invasive species crisis is hamstrung by knowledge gaps that exist between practitioners and academics. We attempt to bridge these gaps by harnessing their combined knowledge (a.k.a. "knowledge co-production") through a novel expert-elicitation exercise. To achieve this, we assembled a diverse, interdisciplinary panel of 15 experts—spanning academia, state and federal agency biologists, and land managers. This panel then ranked the knowledge-priority and impacts of known invasive terrestrial vertebrates in the Southeast, resulting in a list of the 12 highest-priority species. Next, we determined what information was most critical to assess species' potential for future spread, including habitat preferences, relative prevalence, thermal physiology, spatial ecology, demographic parameters, sources of mortality, and limitations to expansion. We then designed a novel web-based interactive software application (using R and *Shiny*) which allowed panelists to enter information, along with self-reported confidence levels, resulting in replicated estimates and associated uncertainties for each variable. Importantly, this application provided panelists with the ability to intuitively quantify spatial patterns in species' prevalence using an adapted touch-based algorithm (Javascript), yielding hundreds of invaluable abundance maps across the Southeastern US. This software also processed data in real time (i.e., QA/QC, bias corrections, calculating uncertainty, and producing reports), allowing panelists to review summaries and make amendments during the workshop itself. We further demonstrate how these data can be used to model invasion dynamics with a case study featuring Burmese pythons, the highest priority species identified by panelists.

Bulimulus spp. Interdisciplinary Working Group: Managing an Invasive Snail in the SE and Gulf States

Shirley Baker[1]*, Mark Abney*[2]*, Francisco Borrero*[3]*, Lauren Diepenbrock*[4]*, Xavier Martini*[5]*, Rory Mc Donnell*[6]*, Faith Oi*[1]*, Nicole Quinn*[7]*, and Sudeep S. Sidhu*[5]

[1]University of Florida, Gainesville, FL USA
[2]University of Georgia, Tifton, GA USA
[3]USDA National Malacology Laboratory, Philadelphia, PA USA
[4]University of Florida, Citrus Research and Education Center, Lake Alfred, FL USA
[5]University of Florida, North Florida Research and Education Center, Quincy, FL USA
[6]Oregon State University, Corvallis, OR USA
[7]University of Florida, Fort Pierce, FL USA

Invasive species pose significant threats to agriculture worldwide and, among them, the land snail *Bulimulus* spp. is emerging as a formidable invader with potential economic consequences. Among the already recognized and potentially worsening impacts on agricultural practices resulting from these snails are interference with processes such as irrigation and harvesting, as well as direct crop consumption and overwhelming of crop plants by large numbers of snails. This poster introduces an interdisciplinary working group dedicated to studying the invasive snail, *Bulimulus*. The working group brings together experts from diverse fields such as ecology, systematics, entomology, agronomy, genetics, pest management, horticulture, and malacology to address the multifaceted challenges associated with the spread of *Bulimulus*.

The working group aims to: document spread and agricultural impacts of *Bulimulus* in the southeast and Gulf states, conduct experiments to determine ecology and effective management options for *Bulimulus,* synthesize research findings, deliver extension materials to stakeholders, and develop proposals to address evidence-based management practices throughout its invaded range.

This poster will highlight the importance of a collaborative, interdisciplinary approach to address the challenges posed by relatively unknown invasive species like *Bulimulus*. By fostering communication and knowledge exchange among experts, the working group strives to provide a comprehensive framework for effective management strategies, ultimately promoting resilience of agricultural systems facing the threat of *Bulimulus* invasion.

Thinking Differently about Early Detection and Rapid Response and Invasive Species Outreach

Chuck Bargeron[1]*, Mike Ielmini*[2]*, Steve Manning*[3]*, Joe LaForest*[1]*and Rebekah Wallace*[1]

[1]University of Georgia, Tifton, GA, USA
[2]USDA Forest Service, Washington, D.C. USA
[3]Invasive Plant Control, Inc., Nashville, TN USA

It has been almost 25 years since the first Executive Order on Invasive Species was signed by President Bill Clinton. Since then, hundreds of millions of dollars have been spent on preventing, detecting, managing, and researching invasive species, but what difference have we truly made? What can we do better? How can we better work together to solve the problem of invasive species? And most importantly, how can we get more of the public engaged and involved in protecting and restoring their favorite places? This presentation will focus on what needs to change and how we change it, focusing on early detection and rapid response, and invasive species outreach**.**

Diversity and Integrated Management Approaches of *Megalurothrips usitatus*, an Invasive Thrips Threatening Legume Production in South Florida and Central America

***Felipe Barreto Da Silva**, Mariana Monteiro de Souza Barros, Cleveland Ivey, Hugh Smith*
University of Florida, Gulf Coast Research and Education Center, Wimauma, FL, USA

Megalurothrips usitatus (Bagnall) (Thysanoptera: Thripidae), is an invasive thrips that originates from the Asian tropics and was first reported in Florida in 2020. It has also been reported in Costa Rica, Cuba, Guatemala, Honduras, Mexico, Nicaragua, and Puerto Rico. *Megalurothrips usitatus* is a threat to legume crops, and it has already caused significant economic damage to snap beans (Phaseolus vulgaris) in Florida. Growers of snap beans have reported the need to apply insecticides at earlier stages and more frequently, which has resulted in increased production costs. The University of Florida, Guatemala's Instituto de Ciencia y Tecnología Agrícola (ICTA) and CIAT are collaborating on a regional plan to strengthen diagnostic ability and produce management guidelines for *M. usitatus* in legumes in the Central American region. For better understanding the distribution and possible genetic diversity between populations of M. usitatus, surveys were conducted in 20 commercial fields of snap bean in Florida, distributed in Miami-Dade and Hendry Counties, and fields from Guatemala and Honduras. Despite the intensive chemical treatment of the crop, significant losses are still being reported by Florida snap bean growers. The susceptibility to insecticides of M. usitatus, and alternative pest control measures, such as the usage of mite and entomopathogenic nematodes, are being assessed. The results of this research have been used to develop *M. usitatus* management guidelines for growers.

Using Environmental DNA to Assess the Northern Geographic Extent of Burmese Pythons in Florida

Caitlin E. Beaver[1]*, Alexis Tays*[2]*, Margaret E. Hunter*[1]

[1]United States Geological Survey, Gainesville, FL, USA

[2] Cherokee Nation System Solutions, Gainesville, FL USA

Burmese pythons (*Python bivittatus*) are established as an invasive species in the Greater Everglades Ecosystem. Methods to assess the geographic extent of Burmese pythons are largely based on physical removal and visual surveys which have detection rates of <1%. The current northern boundary of the invasive Burmese python population is estimated to be south of Lake Okeechobee. However, this geographic estimate is largely based on sightings and captures, and low visual detection probability makes delineating the true geographic extent of the population difficult. Environmental DNA (eDNA) is a survey tool being used to identify Burmese python occurrence throughout southern and central Florida by isolating DNA in an environmental sample. This passive method of python detection has increased detection rates (38-100%) depending on a variety of environmental compounds that inhibit PCR. Our objective was to evaluate eDNA as a multi-year monitoring tool for a semi-aquatic, invasive species with high dispersal ability. From 2019 to 2023, we collected >700 water samples across a large geographic area between central Florida and the southern border of Lake Okeechobee. We surveyed 85 unique geographic sites, including 26 sites sampled multiple years, to assess change in occupancy over time. The 59 single-survey sites provide a snapshot detection estimate for that area in time. We tested for Burmese python eDNA presence using probe-based droplet digital PCR technology for absolute quantification of target eDNA. We then used hierarchical occupancy models to account for imperfect detection at sites resampled multiple years to estimate python occupancy in areas north of what is currently considered the invasion front for Burmese pythons in Florida. Applying passive, but highly sensitive detection of eDNA across a large geographic area can help inform management of the true extent of this invasive species.

Response of an imperiled endemic Florida crayfish *(Procambarus pictus)* to an invasive congener *(Procambarus spiculifer)*

Sara A. Bolds *and Lindsey S. Reisinger*
Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL, USA

The Black Creek crayfish *(Procambarus pictus)* is a critically imperiled crayfish endemic to the Black Creek drainage in northeast Florida. The species was already threatened due to habitat loss and degradation, and the rapid spread of an invasive congener (the white-tubercled crayfish; *Procambarus spiculifer)* has exacerbated the decline of *P. pictus* populations. Competition with *P. spiculifer* has led to the extirpation of *P. pictus* at many sites where populations were otherwise expected to persist. Additionally, both species are hosts for a microsporidian parasite that is associated with deterioration of muscle tissue and mortality. Surveys are being conducted to examine changes in *P. pictus* populations and microsporidian disease prevalence across their range as a result of the *P. spiculifer* invasion. Preliminary data supports previous observations that *P. spiculifer* eventually replaces *P. pictus* at sites where they both occur, and surveys have identified diseased individuals of both species throughout the region.

Disruption or Replacement? The Role of the Invasive Brazilian Peppertree in Coastal Nutrient Cycling

Kristian H. Taylor[1], Ashley E. Fitzgerald[2], ***Campbell C. Bonner[1]***

[1]University of Tampa, Tampa, FL, USA.

[2]Georgia Sea Turtle Center, Jekyll Island, GA, USA.

The mangrove crab, *Aratus pisonii*, is a key organism in mangrove ecosystems, feeding on live and senescent mangrove leaves. The corresponding detrital and fecal material produced is a foundational component of an ecologically important nutrient cycle. Brazilian peppertree, *Schinus terebinthifolius*, is an invasive species that displaces mangroves, which could possibly disrupt the ecosystem of these important coastline habitats. This study focused on the interactions between *A. pisonii*, *S. terebinthifolius*, and the red mangrove (*Rhizophora mangle*). In a laboratory setting with three different treatments (only mangrove leaves, only peppertree leaves, and a combination of the two), crab herbivory interactions were recorded by video and were analyzed. Mangrove crabs did not avoid the Brazilian peppertrees. Conversely, they were found staying on, and scraping the leaves briefly when those were the only leaves provided. When both leaf types were present, crabs preferred the leaves of *R. mangle,* although there were non-significant instances of crabs scraping at peppertree leaves. This was in contrast to in-situ observations of approximately 300 peppertrees in the Tampa Bay area which revealed that *A*. *pisonii* was not colonizing this invasive species. These findings, despite being preliminary, demonstrate that the impact of peppertrees on coastal nutrient cycles isn't quite clear yet. Although a preference for *R. mangle* by mangrove crabs was demonstrated, crabs did seem to attempt to feed on the leaves of *S. terebinthifolius.* Further work is necessary to elucidate this invasive's role in coastal nutrient cycling facilitated by *A pisonii*. If an avoidance of *S. terebinthifolius* leaves is established, this may affect the distribution of mangrove crabs and resultant nutrient cycle as the peppertree further invades coastal habitats.

Fish Slam: Eleven Years of Collaborative Non-native Fish Monitoring

Mary Brown[1]*, Kelly Gestring*[2]*, Nick Trippel*[3]*, Wes Daniel*[1]*, and Pam Schofield*[4]

[1]U.S. Geological Survey-Wetland and Aquatic Research Center, Gainesville, FL, USA
[2]Florida Fish and Wildlife Conservation Commission, Davie, FL, USA
[3]Florida Fish and Wildlife Conservation Commission, Eustis, FL, USA
[4]Emeritus U.S. Geological Survey – Wetland and Aquatic Research Center, Gainesville, FL, USA

Dozens of species of non-native fishes are present in the fresh waters of Florida, and additional non-native species are discovered each year. Maintaining current information on the geographic ranges of all non-native fishes is a challenging task, as many jurisdictions are involved at the state, federal, and municipal levels. There is a need to coordinate sampling, research, and management across jurisdictional boundaries while also providing up-to-date geographic distribution information to publicly accessible databases. In 2013, US Geological Survey (USGS) and Florida Fish and Wildlife Conservation Commission (FWC) fish biologists began working together informally to build the Florida Non-Native Fish Action Alliance. This group is comprised of many agencies, universities, and non-governmental organizations. While our agencies' missions may differ, we recognize the need to work together to document and manage non-native fishes in Florida. One way the alliance works toward these goals is through Fish Slams. Fish Slam events are similar to a bioblitz where teams of fishery professionals converge for a day of sampling.

Invasive Reptile-Mediated Risk of Mosquito-Borne Pathogen Transmission

Nathan Burkett-Cadena [1], *Melissa Miller* [2], *and Lawrence Reeves* [1]

[1]University of Florida, Florida Medical Entomology Laboratory, Vero Beach, FL, USA

[2] University of Florida, Fort Lauderdale Research and Education Center, Fort Lauderdale, FL USA

Florida ranks first in the world in number of nonnative reptile species. Dozens of species of nonnative snake and lizard are established in southern Florida and the ranges of many are expanding northward. Numerous direct negative impacts of invasive reptiles have been recorded in Florida, including decreased abundance of native species due to predation and competition. While these direct impacts on native communities are important and well-documented, they may be overshadowed by potential indirect impacts of invasive reptiles in Florida, especially their effects on the ecology of mosquito-borne parasites and pathogens. Our recent work demonstrated that these invasive reptiles have disproportionate influence on the hosts bitten by mosquito species that transmit deadly viruses (West Nile virus, eastern equine encephalitis virus) and wildlife parasites (avian malaria) by altering the community of vertebrate hosts available to vector mosquitoes. This is notable, because the hosts available to and bitten by vectors is a major driver of mosquito-borne pathogen transmission.

The Burmese python, for example is causing the decline of several larger mammal species in South Florida, resulting in the vector mosquitoes taking a majority of blood meals from rodents, which are hosts of several human pathogens in the region. The brown anole lizard, an important host of several vector mosquitoes in Florida, is being displaced by the larger, aggressive invasive Peters's rock agama. As these invasive reptiles expand their ranges northward, human risk of mosquito-borne disease may increase, due to vectors feeding more heavily on reservoir and amplifying hosts of human pathogens (rodents and birds). In this way, an invasive reptiles may indirectly impact the transmission ecology of mosquito-borne disease of both humans and wildlife, highlighting links between invasive species and OneHealth.

Influence of Temperature on the Biting Persistence of *Aedes aegypti,* a Key Invasive Vector in Florida

Simon A. Casas[1]***,*** *Yasmin Ortiz*[12]*, Panpim Thongsripong*[12]

[1]Florida Medical Entomology Laboratory, Vero Beach, FL USA

[2]University of Florida, Gainesville, FL, USA

Mosquito-borne diseases such as dengue and Zika, transmitted primarily by *Aedes aegypti*, pose a growing global public health burden. *Ae. aeygpti,* an invasive vector species in United States, is found throughout urban and suburban locations in southern and eastern Florida with predicted northward range expansion due to global climate change. Change in temperature have also been shown to impact *Ae. aegypti* gonotrophic cycle length, thus altering the biting rate that drives disease transmission. However, mosquito biting activity is a two-way process influenced by factors such as host defensiveness and mosquito biting persistence. Thus, assessment of temperature's impact on mosquito biting behavior in addition to gonotrophic cycle length will better inform how changes in temperature may influence this dynamic process. Currently, there is no biological data on how temperature changes impact *Ae. aegypti* biting persistence. This study aims to determine the relationship between temperature and vector biting persistence with results applicable to model-based prediction of mosquito-borne disease transmission in a changing climate. Laboratory experiments are conducted using *Ae. aegypti* laboratory colonies, subjecting them to different temperature treatments (18°C, 23°C, 28°C, and 33°C). Biting persistence is quantified by assessing the number of landings on a human arm during a 1-hour test and the average resting time between feeding attempts. Factors such as mosquito size (fitness), age, and humidity are also considered. Preliminary results from our ongoing experiments show an optimal temperature range for maximum biting persistence in *Ae. aegypti*, with excessively high or low temperatures leading to reduced persistence and potentially impacting blood-feeding success and disease transmission rates. This study provides insights on the direct influence of temperature on *Ae. aegypti* biting persistence and enhance our understanding of how climate change may influence mosquito-borne disease transmission via changing human-mosquito contact rates.

Impacts of Green Iguana to Property, Infrastructure, and Safety in Florida

***Natalie M Claunch**, Bryan M Kluever*
USDA, APHIS, Wildlife Services, National Wildlife Research Center, Florida Field Station, Gainesville, FL, USA

Green iguanas (*Iguana iguana*), large-bodied lizards native to South and Central America, have established multiple invasive populations worldwide. Where established, invasive green iguanas are documented to impact agriculture and horticulture, infrastructure and human safety, the natural environment, and private property. The majority of attempts to quantify impacts of invasive green iguana have been conducted in Puerto Rico or are limited to singular reports. Green iguanas have been established in Florida since 1966 and are currently a high management concern with need for research on control methods. Impact data from Florida to justify these efforts are often anecdotal or out of date. Using nuisance wildlife report data collected from the Florida Fish and Wildlife Commission's Wildlife Impact Management Section and take reports from the USDA Wildlife Services Management Information System, we present an updated assessment of green iguana impacts and costs to property, infrastructure, and safety in Florida over time and space. These estimates may have utility to various stakeholders in conducting cost-benefit assessments of research and management options.

A Global Analysis of the Impacts of Free-ranging Dogs on Native Wildlife

***Ally E. Cobern[1]**, Garrett D. Ake[1], Patricia J. Hartman[1], Kylee Z. Dunham[2], Christopher A. Lepczyk[1], Jean E. Fantle-Lepczyk[1]*

[1]Auburn University, Auburn, AL, USA
[2]Cornell Lab of Ornithology, Ithaca, NY, USA

Free-ranging dogs are a global threat to wildlife due to multiple factors, including predation and trampling. While the diets of free-ranging cats have been documented more frequently, and the result of a synthesis of that data has demonstrated significant concern, there has not been a thorough compilation and analysis of the effects of dogs on other species. Given that dogs depredate many of the same species as cats, free-ranging dogs are also impacting the environment in negative ways. Considering the global problem of free-ranging dogs, our goal is to quantify the ecological effects on other species. We hypothesize that free-ranging dogs are a major contributor to native species depredation and are environmentally as damaging as free-ranging cats. To address this, we are conducting a structured review of the primary literature regarding free-ranging dogs using Web of Science and Google Scholar. We are currently analyzing the 2000+ articles to evaluate species impacted by dogs, if they are of conservation concern, and if there are traits related to these species. We are categorizing effects by species, location, and method to identify any and all possible patterns. From the final database we will be able to determine locations where free-ranging dogs are having the greatest impact on biodiversity and which taxa are most threatened by them in order to provide management guidance.

Determining the Origin of Migrating Birds Consumed by Burmese Pythons while Overwintering in Florida

***Kate Davis**, Alexandra Fireman, Christina Romagosa, and Hannah Vander Zanden*
University of Florida, Gainesville, FL, USA

Feathers from migrating birds offer a unique opportunity to understand the geographical impacts and intricacies of animal behavior in the face of invasive threats. Though Burmese pythons (*Python molurus bivittatus)* have long been identified as threats to native fauna, the foraging behavior of this invasive species on native avian species may have further geographical reach than previously understood. Visual analysis of feathers from the digestive tracts of pythons removed from the Everglades has identified more than a dozen species of bird that overwinter in Florida. In this study, I used the geographic history reflected in the isotope values of feathers to better understand invasive Burmese python foraging behavior in Florida.

We used hydrogen isotope (δ^2H) values of feathers recovered from python guts to determine their likely origin and characterize the geographic extent of python impacts to avian species in the U.S. The δ^2H values of feathers are metabolically inert following their formation and can be used to infer the likely areas where they were grown. During the molting process, birds incorporate local δ^2H values into their developing feathers through dietary and drinking water. Predictable δ^2H isotope gradients (or isoscapes) can be used to identify the likely areas of feather molting locations with the R package. This study comprises a novel application of δ^2H analysis to determine origins of migratory birds killed by invasive species to reveal the geographic reach of the foraging behavior of Burmese pythons in Florida.

Pesticidal Proteins Toxic to the Asian Citrus Psyllid, an Invasive Pest in Citrus

***Morgana S. Miranda**, Clebson S. Tavares, Serena Wang, Ruchir Mishra, Bryony Bonning*
Entomology and Nematology Department, University of Florida, Gainesville, FL, USA

The Asian citrus psyllid (ACP) *Diaphorina citri* transmits the causative agent of huanglongbing or citrus greening disease that has decimated global citrus production. Extensive application of chemical insecticides to suppress ACP populations is the primary strategy for management of this economically important disease. Pesticidal proteins derived from bacteria such as *Bacillus thuringiensis* (Bt) can provide effective and environmentally friendly alternatives for management of *D. citri*, but few with sufficient toxicity to *D. citri* have been identified. Here, we report on the toxicity of 17 Bt-derived pesticidal proteins from five different structural groups against *D. citri* first instar nymphs and adults. These proteins were selected based on previously reported toxicity to other hemipteran species and on pesticidal protein availability. Some proteins were expressed in *Escherichia coli* and purified from inclusion bodies or His-tag affinity purification, while others were expressed in Bt and purified from spore/crystal mixtures. Pesticidal proteins were initially screened by membrane feeding of psyllids on a single dose. To assess toxicity against first instar nymphs, we developed a new bioassay method using membrane feeding that allows for nymph survival for at least 4 days. Lethal concentration (LC_{50}) values were calculated for Mpp51Aa1 and Tpp78Aa1 which showed significant mortality to adults and high mortality against nymphs at 100 µg/mL. The protein Mpp51Aa1 was toxic to *D. citri* nymphs and adults with LC_{50} values of 7.12 µg/mL and 110, respectively. Tpp78Aa1 was toxic to *D. citri* nymphs with an LC_{50} of 19.92 µg/mL and to adults with an LC_{50} of 204.84 µg/mL. We identified two pesticidal proteins with activity against *D. citri* and demonstrated the greater susceptibility of first instar nymphs to pesticidal proteins relative to adults. The proteins Mpp51Aa1 and Tpp78Aa1 provide valuable tools for use in the management of both *D. citri* populations and citrus greening disease.

A Summary of Tegu Control in Everglades National Park

Kevin Donmoyer[1]*, Bryan Falk*[2]*, Peter Xiong*[3]*, Christina Romagosa*[3]*, Amanda Kissel*[4]*, Mark Sandfoss*[4]*, Amy Yackel Adams*[4]

[1]Everglades National Park, Homestead, FL USA
[2]National Invasive Species Council, U.S. Department of the Interior, Washington DC USA
[3]University of Florida, Gainesville, FL USA
[4]U.S. Geological Survey, Fort Collins, CO USA

The Argentine black and white tegu (*Salvator merianae*) is a large lizard native to South America that has established five known populations in Central and South Florida. The southern population in Homestead, Florida, Miami-Dade County, extends into the eastern boundary of Everglades National Park. Shortly after the Homestead population was identified in 2008, tegus were recognized as an urgent threat to the Park's natural resources. Subsequently, a joint trapping effort between the U.S. Department of Interior and the University of Florida began in 2012, with 30 traps deployed along the C-111 canal. Trapping efforts have grown in subsequent years, with over 300 traps located inside and outside the Park. The first tegu was removed from the Park boundaries in 2017 and the first hatchling in 2020. In every year since, all size classes have been observed within the Park. Although most tegus are captured within 2 miles of the Park's eastern entrance, a credible sighting did occur a further 24 miles southwest, near the Snake Bight Trailhead in 2022. The primary method of removal is baiting a commercially available live-trap with a single chicken egg. Utilizing this strategy, over 3000 tegus have been removed since 2019. In attempts to further increase captures, testing of novel baits and scent adjuvants have been assessed, but chicken eggs continue to be the most successful lure. Aside from tegus, our trapping has also captured 71 non-target species, including common hispid cotton rats as well as oddities, such as walking catfish and swamp eels. Although trapping is effective at removing large amounts of tegus from the landscape, continued research and development of new technologies is necessary before eradication in the Park is feasible.

Predation by Invasive Asian Swamp Eels Reducing Populations of Common Fishes and Decapods in the Florida Everglades

***Nathan J. Dorn*[1], *Matthew R. Pintar,*[1,2], *Jeffrey L. Kline*[3], *and Joel C. Trexler*[4]**

[1]Florida International University, Miami, FL USA
[2]Bio-West, San Marcos, TX USA
[3]Everglades National Park, Homestead, FL 33034 USA
[4]Florida State University, Tallahassee, FL USA

Asian swamp eels (*Monopterus albus/javanensis;* Synbranchiformes; ASE) are spreading throughout Florida and are threatening the production of small fish and crayfish populations that are integral components of the food web of the Everglades. ASE have been present in canals of southern Florida since 1997 and entered the wetlands a decade later, but analyses have only recently uncovered the degree of their impacts. Using a 26-year dataset of fish and decapod densities collected in the eastern 254 km^2 drainage of Everglades National Park we modeled the densities of the nine most abundant prey fish and decapods using hydrologic terms for the before eel period (1996-2010), then added the after eel ("eel established") data (2015-2022) to detect effects of the eels (before vs. after). After accounting for wetland hydrologic variability through time we observed that six species had declined in the wetland after ASE establishment but did not decline in nearby wetlands without ASE. Populations of two crayfishes (*Procambarus* spp.) and two fishes (*Jordanella floridae, Fundulus confluentus*) sustained 85-99% losses and two other abundant fishes (*Gambusia holbrooki* and *F. chrysotus*) had significant density losses (44-66%) after establishment of ASE. Three species did not decline. Recent invasions of other larger drainages in the Everglades are pointing towards expanding ASE impacts. The affected species are energetically important prey species for seasonally nesting wading birds, meaning that ASE may impact ecosystem restoration targets. The affected species also have relatively drought-resistant life histories that benefit from seasonal low water depths in the Everglades. Hydrologic droughts are disturbances for native predatory fishes in the Everglades, but ASE seem capable of establishing and maintaining populations under shallow conditions, making it a novel predatory phenotype in the Everglades and a potential threat to the biodiversity in shallow aquatic ecosystems in other parts of North America.

Bacillus thuringiensis-derived Pesticidal Proteins Toxic to the Whitefly, an Invasive Agricultural Pest

***Clebson S. Tavares**, Serena Wang, Ruchir Mishra, Bryony Bonning*
Entomology & Nematology Department, University of Florida, Gainesville, FL, USA

The sweet potato whitefly, *Bemisia tabaci*, is a highly destructive, invasive agricultural pest. Damage results from direct feeding, mold associated with honeydew excretion, and the transmission of numerous plant viruses impacting a wide range of host plants including vegetables, field and ornamental crops. Whitefly management entails extensive use of chemical pesticides, particularly neonicotinoids, and insecticide resistance is now widespread. While pesticidal proteins from *Bacillus thuringiensis* (Bt) and other entomopathogenic bacteria potentially provide environmentally friendly alternatives to chemical pesticides, only one protein was known to be active against *B. tabaci*. Here we report on the toxicity of 11 Bt-derived pesticidal proteins from several different structural classes against *B. tabaci* Middle East-Asian Minor 1 (MEAM1). These proteins were either expressed in Bt and purified from crystals or expressed in *Escherichia coli* and purified from inclusion bodies or His-tag affinity chromatography. The toxicity of purified proteins was first assessed by feeding adult whiteflies on a single dose followed by lethal concentration (LC_{50}) determination for proteins with significant mortality relative to the buffer control. The proteins Tpp78Aa1, Tpp78Ba1, and Cry1Ca were toxic to *B. tabaci* with LC_{50} values of 99, 96, and 351 µg/mL, respectively. These proteins provide valuable tools to mitigate losses associated with *B. tabaci* and the numerous plant viruses transmitted by this insect.

GeoPathome: An Interactive Web-scraping Tool for Global Pest and Pathogen Risk Analysis

Berea A. Etherton[1,2,3], *Karen A. Garrett*[1,2,3]

[1]Plant Pathology Department, University of Florida, USA
[2]Global Food Systems Institute, University of Florida, USA
[3]Emerging Pathogens Institute, University of Florida, USA

The risk of pest and pathogen introduction is increasing due to expanding global agricultural trade. Integrated decision-support systems can help identify strategic management interventions to mitigate these risks, and better understand the likely introduction points for invasive pests and pathogens. Here we introduce GeoPathome, an interactive RShiny application designed to inform users about potential pathogen introduction points. This app leverages web-scraping capabilities in the RSelenium library to extract international trade data from UN FAO and Comtrade, focusing on a wide range of crops, including tomato, potato, banana, and coffee. GeoPathome provides the option to upload the geographic locations where pests and pathogens have been reported, allowing users to explore and analyze import and export data and the risks of pathogen movement through trade. This app updates yearly to provide the latest information. By identifying potential introduction pathways, users can make informed decisions about how to address the risks from imports and exports and improve phytosanitary policies and strategies, including seed testing. This app is designed to contribute to safeguarding global agriculture and mitigating the potential for invasive pest and pathogen introduction.

An Integrative Approach for Robust Invasive Species Risk Assessments

Luke J. Evans[1]*, J. Alex Baecher*[2]*, Joshua A. Cullen*[3]*, Wesley M Daniel*[4]*, Christina M. Romagosa*[1]*, Blake Blaskowski*[4] *and Brett R. Scheffers*[1]

[1]Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA
[2]School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA
[3]Oak Ridge Institute for Science and Education, Oak Ridge, TN, USA
[4]U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, Florida, USA

A rapid, global redistribution of species is being facilitated by both a shifting climate and a growing demand for exotic pets. Invasion risk analyses traditionally draw on isolated information from field-studies, expert opinion, citizen science, or trait-based suitability approaches. We aimed to assess how species along the invasion curve might pose future invasion risk. We took an integrative approach, utilizing expert opinion (and self-reported confidence), combined with trait-based physiological suitability and examined these factors for species at different stages along the invasion curve. Expert-elicited information took the form of relative prevalence (or apparent abundance) of a species, as well as habitat suitability within known ranges and beyond. Physiological suitability was assessed using a biophysical model through the NicheMapR software. We were able to validate our findings with citizen science data held in the EDDMapS database. We identified spatially-explicit areas that pose a high risk for future invasion, whether by new incidental releases of individuals, expansion of existing individuals due to climate change, or through habitat alteration. These high risk areas represent locations where management (e.g., removal of individuals) may be most effective in preventing establishment or spread. Further, by combining mechanistic models and expert-elicited information to estimate both relative prevalence and habitat suitability, we provide a new standard for future invasion risk assessments.

Introduction to the Leftovers Initiative: Identifying Gaps in Invasion Ecology

Paul Evans
Invasion Science Research Institute, UF/IFAS, Gainesville, FL, USA

The state of Florida has had hundreds of vertebrates species that have been introduced or established over the past century. Several of these species are well known and heavily managed or monitored leading them to be likely considered as our 'flagship' invasive species. However, the great quantity of species introduced lead to several species being understudied and leave knowledge in gaps in their ecology. Smaller and medium sized species can be more difficult to study and thus their ecological impact less understood. The use of citizen scientist reporting has collected greater range data than ever before. Species of interest are Peter's Rock agama (*Agama picticauda*), Cuban Knight anole (*Anolis equestris*), Mediterranean gecko (*Hemidactylus turcicus*), Northern Curly-tailed lizard (*Leiocephalus carinatus armouri*), Brown basilisk (*Basiliscus vittatus*), Grey-headed swamphen (*Porphyrio poliocephalus)*, Monk Parakeet (*Myiopsitta monachus*), Common mynah (*Acridotheres tristis*). Through a mix of habitat index analysis and bibliometric analysis we aim to begin identifying what we do know and what knowledge gaps remain with many species. The hope of this initiative is to acknowledge the gaps and implement ways for some of these to be closed and inform managing and monitoring efforts. Preliminary results for habitat variation reveal several species had significant changes between seasonal shifts and could aid in improving monitoring of species with little to no distribution records on.

Identifying Cost-Efficient Management Options for the Critically Endangered Puaiohi, (*Myadestes palmeri*)

Jean Fantle-Lepczyk
Auburn University, Auburn, AL, USA

Invasive species pose great threats to native species, particularly island endemics. Often the costs to mitigate the effects of invasives are borne by already financially constrained conservation organizations, necessitating the identification of cost-effective management strategies before committing significant funds and time. Based on currently proposed interventions for the endangered Hawaiian endemic puaiohi (*Myadestes palmeri*), we constructed population viability analysis models and estimated monetary costs for proposed management activities to address the threats posed by invasive species, including predation, competition for food, and habitat degradation. Specifically, we modeled ten scenarios, including rat control at puaiohi nests; habitat-wide rat suppression; habitat-wide rat eradication; habitat restoration; supplemental feeding; provision of nest boxes; habitat restoration coupled with rat control, suppression, or eradication; and translocation of a second population to improved habitat. We considered several different options for achieving a management objective and calculated total and per capita costs of that option over 25 years. All ten models indicated substantial increases in growth rate, population size, time to extinction, and lower probabilities of extinction compared to the baseline model. However, each yielded markedly different per capita and total costs: the least expensive was translocation from the wild, while the most expensive options involved rat suppression with bait stations. However, even these scenarios were more cost efficient than the current expenditures baseline model, which only costs ~$2.5 million but resulted in the species' extinction in ~16 years. No significant relationship was found between either total cost or per capita cost in relation to probability of extinction or growth rate, or per capita costs and population size after 25 years, though the relationship between population size and total costs was significant. We conclude that a suite of cost-effective management exists to mitigate the effects of invasive species and protect the endangered puaiohi from the threat of extinction.

Refining Integrated Pest Management for Waterhyacinth (*Pontederia crassipes*) in Lake Okeechobee

***Seth Farris*[1], *Melissa Smith*[1], *Lyn Gettys*[2], *Megan Reid*[2], *J. Matthew Hoch*[3], *Jessica M. Fair*[4], *Carey Minteer*[5]**

[1]USDA-ARS Invasive Plant Research Laboratory, Davie, FL, USA
[2]University of Florida IFAS Research and Education Center, Davie, FL, USA
[3]Nova Southeastern University, Davie, FL, USA
[4]U.S. Army Corps. Of Engineers, Jacksonville, FL, USA
[5]University of Florida IFAS Indian River Research and Education Center, Fort Pierce, FL, USA

Waterhyacinth (*Pontederia crassipes*), is an invasive floating plant that forms large, impenetrable mats. Introduced to the United States during the late 19th century, it is currently one of the region's worst invaders. Lake Okeechobee is centrally located in Florida and is considered the primary source of water for the Everglades. Development and agricultural run-off from upstream nonpoint sources have resulted in a physically and biologically altered lake. Eutrophic conditions have encouraged the growth of algal blooms, waterhyacinth, and other invasive aquatic weeds that negatively affect wildlife, boating, and angling. Annual control is costly to manage, but federally mandated.

Foundational experiments performed in mesocosms demonstrated that the rate of herbicide use could be drastically reduced when integrated with biological control. By replicating these experiments on a larger scale in Lake Okeechobee, we are studying the efficacy of these methods *in situ*. The experimental design is a 2 x 3 x 2 factorial with 2 herbicides (2,4-D and Penoxsulam) sprayed at 3 rates (operational, half rate, and a control with water only) and 2 "spray styles" (complete cover and "skips") arranged in a completely randomized design with 4 replications for a total of 48 plots. Each plot measures 5m by 8m with a 5m buffer in between. Plots are delineated using floating booms with a 10cm skirt that confines the vegetation while allowing normal water flow. All plots have *Megamelus scutellaris* plant hoppers and *Neochetina* weevils present as biological control agents. Vegetation coverage within plots will be surveyed monthly using aerial photography (RGB and multispectral) obtained from 50m above the plots. Fish and macroinvertebrate communities are also examined at each of these plots by utilizing baited minnow traps. We aim to produce best integrated management practices for freshwater lake communities in Florida impacted by waterhyacinth in order to restore this critical ecosystem.

Urban Evolved Invasive Plant Tolerates Experimental Climate Change

S. Luke Flory[1]*, Drew Hiatt*[1]*, Jesse Borden*[2]*, Damjana Levacic* [3]*, and Sven Jelaska*[3]

[1]University of Florida, Gainesville, FL, USA
[2]Hobart and William Smith, Geneva, NY, USA
[3]University of Zagreb, Zagreb, Croatia

Urban areas create unique conditions that can drive rapid evolution of species, and they are focal points for the introduction and establishment of non-native species. Introduced species that evolve under urban conditions may have traits that provide them an advantage under climate change. We tested the hypothesis that urban-evolved invaders are adapting to future climate conditions using urban and rural populations of the widespread invasive plant *Erigeron annuus* in and near Zagreb, Croatia. First, we measured plant size and site conditions at 16 rural and 16 urban sites, and then collected seed from each population for an experiment in Florida. We found that plants at urban sites were significantly shorter than those at rural sites, which corresponded to more impervious surface, dramatically lower soil moisture, and higher temperatures at urban sites. In the growth chamber experiment, plants from rural populations were larger than plants from urban populations under optimum environmental (i.e., temperature, moisture) conditions. However, plants from rural populations were significantly smaller under experimental warming, whereas urban populations were unaffected. Similarly, urban populations suffered significantly less under the low water and combined warming + low water treatments in the experiment compared to rural populations. These results demonstrate that *Erigeron* has evolved in response to the hotter and drier conditions in urban sites and that these adaptations make them more resilient to simulated climate change conditions. Adaptation of rural populations towards a more exploitative resource use strategy and evolution of urban populations towards conservative resource use is supported by predictions from the leaf economics spectrum and suggests that urban-evolved invaders may present a greater threat under warmer and drier future climates.

Nonindigenous Fishes in the Fresh Waters of Florida

***Andrew I. Furness**, Robert H. Robins, Zachary S. Randall, and Larry M. Page*
Florida Museum of Natural History, University of Florida, Gainesville, Florida, USA

Forty-nine (29%) of the 170 species of fishes reproducing in the fresh waters of Florida are nonindigenous species. Using data primarily from the Florida Museum of Natural History and other natural history collections, we investigated the worldwide geographic origin of the introductions, rate of introduction over time, location of first detection within Florida, means of introduction by humans, and rate of spread within Florida. Twelve introductions are from elsewhere in the United States, and 37 are from other countries. The number of introduced species from other countries is far more than in other states, and this presumably results from the combination of warm annual temperatures and the large tropical fish industry in Florida. Between 1951 and 2005, introduced species accumulated at a rate of around 0.82 species per year, or 1 species introduced approximately every 1.2 years. Most introductions (>50%) appear to result from escapes from aquarium fish facilities in Miami and Tampa or through aquarium release. To date, most introduced species show a modest rate of spread among major river drainages, with a minority of species rapidly spreading between drainages. Results are of general interest in understanding temporal and spatial patterns of introduction and spread and may help formulate strategies to prevent new introductions and control spread. However, research is needed to better understand variation in the success of establishment and spread of nonindigenous species. A paucity of life history and ecological data on most nonindigenous fishes limits our ability to predict and manage introductions, distributions, and impacts. Taxonomic studies are needed on several introduced fishes before species identifications can be confirmed and ecological data assessed.

Assessment and Surveillance of Argentine Black and White Tegu Abundance in Charlotte County, FL, USA

Alex S. Furst[1,2]*, Vance Young*[3]*, Christina M. Romagosa*[2]*, Steve A. Johnson*[2]*, Martin B. Main*[2]*, E. Hance Ellington*[1,2]

[1]Range Cattle Research and Education Center, UF/IFAS, Ona, FL, USA

[2]Wildlife Ecology and Conservation Department, UF/IFAS, Gainesville, FL, USA

[3]Florida Fish and Wildlife Conservation Commission, Fort Myers, FL, USA

Invasive species represent a significant threat to global biodiversity and cause substantial economic burden to the United States. The spread of invasive species is often regarded as the second greatest threat to global biodiversity behind habitat destruction, as invasive species can change ecosystem function, alter habitat structure, and can outcompete native species for resources. The Argentine black and white tegu (*Salvator merianae;* tegus) are large-bodied, active foraging lizards that were introduced to Florida via the pet trade. There are at least four breeding populations of tegu in Florida. Tegus are generalist omnivores and consume numerous animal groups and their eggs, including some of Florida's keystone species such as the American alligator (*Alligator mississippiensis*) and the Gopher tortoise (*Gopherus polyphemus*). Successful tegu management plans require accurate estimates of abundance and spatial extent. With accurate estimates of density and spread in an area, management agencies can deploy effective and efficient control efforts for tegus and monitor effectiveness of these efforts. We sought to estimate the population abundance and spatial extent of the breeding population of tegus in Charlotte County. We used a combination of live traps in the core introduction area and camera traps in the assumed peripheral area. We are developing population estimates using removal model framework with tegu trap data collected from 2018-2024. Key components of precise population estimates using this method are equal and consistent trap effort and trap susceptibility. We are estimating spatial extent of the tegu population from our network of camera traps. Beyond generating estimates of tegu abundance and spatial extent, our efforts have also revealed the challenges of deploying effective invasive species management in predominantly privately owned land. But we have also demonstrated a potential blueprint for management agencies to conduct invasive species removal efforts while also collecting data in a robust manner.

Crayfish Barrier Construction to Conserve Imperiled Black Creek Crayfish

***Danielle Ganas*[1], *Blair Hayman*[1], *Kasey Fralick*[1], *Isabel Evelyn*[1], *David Cook*[1], *Lindsey Reisinger*[2] *and Sara Bolds*[2]**

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

[2]University of Florida, Gainesville, FL, USA

The introduction of non-native species can alter community structure and result in the replacement of native species. Non-native crayfish are a threat globally and competitive advantages combined with life history advantages have resulted in local extinctions of native crayfishes in favor of non-native invaders. In northeast Florida, the state-Threatened Black Creek crayfish (BCC; *Procambarus pictus)* is endemic to the lower St. Johns River basin, and long-term surveys indicate that the species is in rapid decline. The BCC decline is coincident with the introduction and rapid spread of the non-native white-tubercled crayfish (WTC; *Procambarus spiculifer*). Range wide surveys conducted from 2018-2023 indicated a pattern of BCC replacement by WTC. In 59 sites historically occupied by BCC (1976-2012), 45 (76.3%) have been invaded by WTC and BCC have been extirpated from 32 (71.1%) of those 45 sites. In the Black Creek sub-basin, sites where BCC remain without WTC all occur behind a barrier (e.g., culvert, waterfall). Stream barriers are often removed to increase connectivity in aquatic systems, but they can also serve to limit invasions, benefiting rare species. Barriers have been constructed to prevent dispersal of non-native crayfish, although examples in the literature are few and have varying outcomes. We are developing plans to construct an artificial barrier upstream of a small natural waterfall barrier to protect a BCC only population in headwaters. The in-stream barrier will have an overhanging lip with a flow of water over top, a design feature of other successful crayfish barriers. Additionally, experimental trapping to remove WTC downstream of the proposed barrier location is ongoing (2021-present), and to date 2,571 WTC have been collected and removed from 1 km of stream. Construction of artificial barriers and alteration of existing culverts to prevent crayfish dispersal, in tandem with trapping and removal of WTC, may protect at-risk BCC populations.

Evaluating Spatial Distribution, Trapping, and Potential Chemical Control of the Invasive Land Snail *Bulimulus bonariensis* in Citrus

Sankara Ganesh *and Lauren M. Diepenbrock*
University of Florida, Citrus Research and Education Center, Lake Alfred, FL, USA

Bulimulus bonariensis is an invasive land snail species in Florida. It has been infesting commercial crops in recent years, threatening productivity and food security and causing concern among growers. In citrus, *B. bonariensis* has been observed clogging microjets, defoliating young trees in individual protective covers, and girdling trees with pre-existing damage. There is very limited information available on the spatial distribution of these snails in groves, effective trapping methods for monitoring populations, and potential chemical control, which are important to consider when developing management programs. To explore these aspects, flat traps and pyramid traps were placed between trees and along grove edges in an alternating manner at three sites. Traps were checked for snails biweekly over several months. Heat maps generated from the data show that snails are randomly distributed throughout habitats, suggesting that whole grove management may be necessary. Additionally, the relative success of flat traps and pyramid traps varied across sites, suggesting that either could be a more effective monitoring strategy depending on the environment. To evaluate potential chemical control, snails were treated with metaldehyde baits registered for use in Florida citrus and various sprays not registered for snail control but are used by growers to control other citrus pests. Snails were checked for mortality over two weeks. Among the treatments, the metaldehyde baits and abamectin + thiamethoxam spray induced the greatest mortality. The results of this study reveal pertinent information that may be applied to future *B. bonariensis* management.

Plant Invasions Promote Plant Pathogen Emergence

*Ashish Adhikari[1], Brett Lane[1], Amy Kendig[2], Desiree Szarka[3], Margaret Simon[4], Robert Holt[4], Maria Orive[5], Keith Clay[6], Nicole Gauthier[3], Luke Flory[2], Philip Harmon[1], and **Erica Goss**[1]*

[1]Department of Plant Pathology, University of Florida, Gainesville, FL, USA
[2]Agronomy Department, University of Florida, Gainesville, FL, USA
[3]Department of Plant Pathology, University of Kentucky, Lexington, KY, USA
[4]Department of Biology, University of Florida, Gainesville, FL, USA
[5]Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS, USA
[6]Department of Ecology and Evolution, Tulane University, New Orleans, LA, USA

Invasive plants provide an abundant niche for novel assemblages of microbes. While there are well known instances of invasive plants hosting invasive pathogens (e.g., kudzu and soybean rust), this new niche may also be colonized by resident pathogens. Because invasive plants thrive in disturbed areas that occur at the boundaries between urban, agricultural, and natural ecosystems, they can serve as bridges among ecosystems.

The annual C4 grass *Microstegium vimineum* (Trin. A. Camus, stiltgrass) is an invasive species in the United States. Introduced accidentally from Asia to the eastern US in the early 1900s, invasive populations became widespread and abundant nearly 100 years later. It is now distributed in more than 25 midwestern and eastern US states where it can grow to large biomass. *Microstegium* experienced an extended release from pathogens, which were only observed in the last ~15 years. In 2010, foliar fungal pathogens from the genus *Bipolaris* were documented causing epidemics of leaf spot disease on *Microstegium* and co-occurring native grasses in the center of the invasive range of *Microstegium*. The dominant pathogen, *B. gigantea*, was first described in 1911 and is a little studied pathogen of weedy grasses, suggesting it is a local pathogen that expanded its host range to *Microstegium*.

The 2014 US Farm Bill authorized experimental cultivation of industrial hemp (*Cannabis sativa* containing less than 0.3% THC) after more than 60 years of prohibition. Almost immediately, the same *Bipolaris* pathogen responsible for epidemics on *Microstegium* caused massive disease outbreaks on hemp. We will present our evidence to date that *Bipolaris* populations on *Microstegium* are likely sources of disease emergence on hemp.

Does Invasion History Affect Recognition and Responses of Native Crayfish to the Invasive Swamp Eel?

Brandon A. Güell[1]*, Nathan J. Dorn*[1]
Institute of Environment, Florida International University, Miami, FL 33199, USA

The prey naïveté hypothesis (PNH) posits that native prey vulnerability to non-native predators may be exacerbated by failure to recognize and/or appropriately respond due to a lack of shared evolutionary history. Prey naïveté has been proposed as a driving force behind native prey population declines and extinctions following the introduction of novel predators; however, there are still relatively few empirical tests of the PNH. The invasion of the Asian swamp eel (*Monopterus albus/javanensis*) in Florida is of particular concern for Everglades restoration and provides an excellent opportunity to test the PNH in the context of biological invasions. The invasion of this novel and functionally unique predator has been associated with a 95–99% collapse of several common macroinvertebrate and small fish species in the Everglades. The mechanisms responsible for these dramatic declines are under investigation, but we also know relatively little about the predator-prey interaction between swamp eels and native prey. We tested the PNH by examining the behavioral responses of wild-caught slough crayfish (*Procambarus fallax*) collected from sites with varying levels of invasion history (0 and 5+ years of exposure; 0 vs.10 prey generations with swamp eel presence) following exposure to water-borne chemical cues of their native (sunfish) and invasive (swamp eel) fish predators. Preliminary analyses suggest naïve *P. fallax* that respond to their native predators may fail to recognize and respond to swamp eel cues. The continuation of these experiments and analyses will provide useful insight into one potential underlying mechanism for the severe collapse of prey species following the invasion of swamp eels in the Everglades. If behavioral responsiveness is in fact under some type of selection (plastic or genetic), and exposed populations become more responsive, then it may provide a hopeful pathway by which the production of the system could adapt to the invasive predator.

Analysis of Invasive Tegu Diet Composition in Two Florida Populations

***Madison Harman*[1]*, Nicole Fuller*[2]*, Benjamin Baiser*[1]*, Andrea Currylow*[3]*, Amy Yackel Adams*[4]*, Bryan Falk*[5,6]*, Christina Romagosa*[1]

[1]University of Florida, Gainesville, Florida, USA.
[2]Florida Museum of Natural History, Gainesville, Florida, USA.
[3]United States Geological Survey, Homestead, Florida, USA.
[4]United States Geological Survey, Fort Collins, Colorado, USA.
[5]National Park Service, Homestead, Florida, USA.
[6]National Invasive Species Council, Washington D.C., USA

Invasive species are a widely recognized threat to natural ecosystems, particularly in Florida, where introductions are numerous and frequent. Invasive species may negatively impact native species through predation, competition, or the spread of disease, and it is important to quantify these impacts in order to properly assess risk and allocate management efforts. Argentine giant tegus (*Salvator merianae*) are likely threats via all three of these mechanisms. Here we focus on predation by comparing diet composition of two tegu populations at different stages of control: Miami-Dade County (long-term management) and Charlotte County (containment). We identified gastrointestinal contents from 275 tegus caught between 2016 and 2021. We then used a distance-based redundancy analysis to explore potential drivers of diet composition. We identified a total of 3,693 diet items, where each tegu consumed an average of 13.4 ± 6.5 unique diet items. Tegu diets included a diverse range of chordates, invertebrates, and fruits spanning 12 classes, 53 orders, and 97 families. We found that habitat, month, tegu size, and sex were all significant predictors of diet composition, with habitat being the most important and likely reflecting differences in prey availability. Our findings corroborate the generalist nature of tegus through their breadth of prey taxa and ability to survive in both natural and disturbed habitats. This flexibility likely increases the difficulty of extirpation and therefore supports the implementation of swift removal efforts in response to new introductions.

Spatial Analysis of Invasive Pentastomes Infecting Two Populations of Invasive Argentine Giant Tegus in Florida

***Madison Harman*[1]*, Jason Blackburn*[1]*, Melissa A. Miller*[2]*, Benjamin Baiser*[1]*, Andrea Currylow*[3]*, Amy Yackel Adams*[4]*, Bryan Falk*[5,6]*, Christina Romagosa*[1]

[1]University of Florida, Gainesville, FL, USA.
[1]University of Florida, Fort Lauderdale Research and Education Center, Davie, FL, USA.
[3]United States Geological Survey, Homestead, FL, USA.
[4]United States Geological Survey, Fort Collins, CO, USA.
[5]National Park Service, Homestead, FL, USA.
[6]National Invasive Species Council, Washington D.C., USA

Invasion ecology often focuses on the direct effects of invasive species through predation or competition with natives. However, with the rise of One Health initiatives, invaders' influence on pathogen and parasite systems are receiving more attention. Disruptions to these systems can stem from the co-introduction of non-native parasites that spill over into native hosts, or from invaders serving as reservoirs, amplifiers, or dead-end hosts of existing parasites. In this study, we investigate an interesting combination of spillover and spillback in Florida, USA, where invasive Argentine giant tegus (*Salvator merianae*) from South America are acting as definitive hosts for invasive snake pentastomes (*Raillietiella orientalis*) from Southeast Asia. We analyzed spatial patterns of infection using Kernel Density Estimation and Getis-Ord statistics. We also examined potential drivers of infection intensity using a zero-inflated negative binomial model. We found that pentastome prevalence in Charlotte County (n = 88, 41%) was more than double that in Miami-Dade County (n = 542, 17%), despite being further from the pentastomes' presumed initial introduction site in Everglades National Park. Infection intensity was similarly higher in Charlotte County, with 1.8 ± 4.0 pentastomes per tegu compared to 0.6 ± 3.2 in Miami-Dade County. Analysis demonstrated that infection intensity was significantly associated with habitat, month, and host sex. Clusters of high infection intensities within the landscape did not overlap with clusters of high tegu captures and supported the importance of habitat type, which may serve as a proxy for not-yet-characterized factors influencing observed infections, such as the competency and abundance of intermediate host species. These findings take us closer to unraveling the transmission dynamics of invasive pentastomes in novel hosts and may aid in evaluating potential risk as *R. orientalis* continues to expand its range northward into new areas and host species.

Using Removal Data to Estimate Abundance of Invasive Species to Inform Management Decisions

Daniel Haro[1], *Nathan J. Hostetter*[2], *Amy A. Yackel Adams*[3], *Melissa M. Miller*[4], *Samantha N. Smith*[4], *Mark R. Sandfoss*[3], *Brandon L. Welty*[4], *Andrea F. Currylow*[5], *Frank J. Mazzotti*[4], *and Christina M. Romagosa*[1]

[1] University of Florida, Department of Wildlife Ecology and Conservation, Gainesville, FL, USA

[2] U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC, USA

[3] U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO, USA

[4]University of Florida, Fort Lauderdale Research & Education Center, Fort Lauderdale, FL, USA

[5]U.S. Army Corp of Engineers, NC, USA

Monitoring changes in abundance of wildlife populations is essential for effective management of invasive species. Such monitoring requires reliable population estimates. Populations of cryptic species, such as the invasive Burmese Python in the Everglades, are difficult to estimate, as visual detection of individuals is difficult. Due to the impact of invasive Burmese pythons on native wildlife, since 2017 the State of Florida has implemented python elimination programs through the South Florida Water Management District and the Florida Fish and Wildlife Conservation Commission. Since implementation of the removal program, the South Florida Water Management District has removed approximately 7000 pythons. Despite the large number of snakes removed, there exists no assessment of the effect of removals on python abundance in the Everglades. Recent advances in data integration and removal modeling provide new opportunities to use removal data to estimate abundance, which are particularly well suited for species managed through removal programs. We are exploring the integration of multiple data sources to estimate python abundance in the Everglades Francis S. Taylor Wildlife Management Area, specifically contractor python removal data, data from radio-tagged pythons, and other published studies on python detection probability. This work could provide a template for abundance estimation of cryptic species managed through removal programs.

Integrating Pairwise and Community Observations to Inform Impacts of Pollinator Invasions

***Brittany M. Harris**, Hong Liu, Suzanne Koptur*
Florida International University, Institute of Tropical Botany, Miami, FL, USA

Biological invasions can destabilize ecological communities by altering the structure and function of species interactions, yet consensus for pollinator invasions is lacking. Impacts to recipient plant-pollinator communities are often based on long-term pairwise observations. Although insightful for measuring changes in visitation structure and function, they disregard the potential for community restructuring in the presence of novel competitors. Here, we provide an integrated approach. We assess long-term impacts of two exotic buzz-bees, *Euglossa dilemma* and *Centris nitida*, on visitation and reproduction of an endangered buzz-pollinated plant (*Chamaecrista lineata* var. *keyensis*) before and after invasion in the Florida Keys, USA. We used community network analysis to test whether native bees displaced at the pairwise-level partitioned their niche space by switching floral resources. We also tested whether native bee declines were linked to shared floral specialization. Pollinator turnover in the buzz-pollinated plant was high and sustained after invasion, but fruit and seed set were unaltered. Resource switching was not apparent for native bees displaced from the pairwise assemblage. Further, native bees that specialized on shared resources with exotic bees were more negatively impacted than native generalist bees. High floral specialization and resource overlap with novel competitors could have resulted in the significant decline of the native bee. Despite negative consequences of the invasion on the pollinator community, buzz-pollination was unaffected, indicating some degree of functional replacement and maintenance of buzz-pollination.

Synthesis: Consequences of invasions in mutualisms are nuanced and require long-term data often not available for multi-species communities. Our study suggests that long-term pairwise pollination data supplemented with community analysis can better inform ecological consequences of invasions than either method alone.

Investigating the Potential for Morphological Change in Invasive Snakes

Kodiak C. Hengstebeck *and Christina M. Romagosa*
University of Florida, Gainesville, FL, USA

Biological invasions can help elucidate the adaptive capability of species in the face of novel selective pressures, as invasive species are often forced to establish and spread in biogeographic regions that they did not evolve in. These circumstances provide considerable potential for adaptive or plastic responses to occur over relatively short evolutionary timespans. One such species that has been introduced thousands of kilometers away from its native range is the Burmese python (*Python bivittatus*) in southern Florida. Since their introduction, pythons have been implicated in the severe declines of many native mammal populations throughout the Florida Everglades, which have in turn resulted in changes to the python's diet composition in the core of their introduced range. Changes in diet can result in changes to morphology. Skull morphology, in particular, is often under strong feeding-associated selective pressure due to its many ecological functions and influence on an organism's fitness. In this study, we propose to assess changes to the skull morphology of Burmese pythons across their introduced range as a result of temporal shifts in prey species composition. We plan to use use a dataset of >200 python skulls, collected through inter-agency and university efforts from 1995 to 2022, combined with micro-CT technology and geometric morphometric analyses to investigate these changes.

Improving Early Detection and Rapid Response Efforts through Collaboration and Information Sharing

Nicole D. Hernandez, *Aimee C. Agnew, Amy K. Wray, and Brian E. Reichert*
U.S. Geological Survey Fort Collins Science Center, Fort Collins, CO USA

Invasive species pose a significant threat to ecosystems, the economy, and to public health. To address the issues that these species cause throughout the US and its territories, it is imperative to strengthen information sharing and collaboration. Here, we highlight the work of Siren: The National Early Detection and Rapid Response (EDRR) Information System and its efforts to bolster effective collaboration between existing and emerging EDRR projects. As the Information System of a National EDRR Framework, Siren aims to use partner collaboration to not only streamline communications, but also promote the development of a centralized platform that can share data and enhance monitoring and reporting. Moreover, it encourages the active involvement of citizens, scientists, and managers from local, state, regional, and national levels.

To inform the content and design of the Siren system and interactive web application, we have encouraged EDRR practitioners across the U.S. to participate in four Community of Practice (CoP) groups that focus on the Planning, Detecting, Responding, and Reporting of invasive species. Discussions and outcomes from these CoPs will be presented to highlight how they have been pivotal to the creation of Siren. We will also review anticipated products and outcomes of the Siren system, as well as accomplishments to date and how they tie into the greater National EDRR Framework.

Asian Swamp Eel Prey Use in the Everglades Depends on Invasion History

***Alyssa Herrera**, Brandon A. Güell and Nathan J. Dorn*
Department of Biological Sciences and Institute of Environment, Florida International University, Miami Springs, FL, USA

The Asian Swamp Eel, *Monopterus albus*/*javanensis*, is a tropical synbranchid fish that has been spreading throughout the Florida Everglades and reducing populations of several native species in the wetlands. Some decimated species of prey were only minor components in earlier diet studies of swamp eels. We dissected eels and quantified prey use of populations from across the Everglades regions with different invasion histories to investigate changes to the prey use near and far from the invasion front. Our specific objectives were to (1) quantify the ontogenetic (size-dependent) diet shifts and (2) compare prey use between regions with recent eel colonization (1-5 y since first detection) or more established populations (6-15 years since first detection). We expected that prey deemed to be sensitive from time series analyses of densities would be found in guts of eels from recently colonized regions, but not as common in eels collected from long-established populations. We dissected 493 Asian Swamp Eels (139 - 853 mm TL) from five regions and 77% (*N* = 384) had identifiable contents in their gut. Use of amphipod, dipteran, and coleopteran insects declined with increasing eel length while use of fish, crayfish, and gastropods increased with size. Odonate larvae were consumed frequently by eels of all lengths. Larger eels (> 300 mm TL) collected from regions with long-established populations showed little to no consumption of crayfish and high use of fish. But eels from more recently colonized regions of the Everglades had diets with higher crayfish biomass and percent occurrences. Our results suggest swamp eels in wetlands consume crayfish more commonly at the front of the invasion before crayfish populations are diminished and in wetlands with long established populations they depend more heavily on species of abundant predator-resistant fish and insects.

Incorporating Climate Change into Risk Screening

***Heidi Himes*[1]*, Kate Wyman-Grothem*[2] *and Chris Castiglione*[1]

[1]U.S. Fish and Wildlife Service, Basom, NY, USA

[2]U.S. Fish and Wildlife Service, Bloomington, MN, USA

Climate matching has long been a key component of invasive species risk assessment. More recently there has been increased interest in how climate change affects a species' long-term establishment or impacts. The U.S. Fish and Wildlife Service developed RAMP (Risk Assessment Mapping Program) to implement the CLIMATE algorithm for invasive species risk screening with a United States focus. In the most recent version, Version 5, five global climate models are used to project an invasive species' climate match to future climate conditions. Future climate matching uses two future climate scenarios: Shared Socioeconomic Pathways 3 (emissions doubling by end of century) and 5 (emissions tripling by end of century), and two time-steps: 2055 (representing time period 2041-2070) and 2085 (representing time period 2071-2100). Incorporating multiple global climate models, scenarios, and time periods shows a range of potential outcomes to account for uncertainty in future climate prediction. RAMP provides a climate match for each individual global climate model as well as aggregated output by scenario and time step. The latter includes maps of median future climate match for the five global climate models and maps showing the difference between current climate match and median future climate match for a given scenario and time step. The climate matching in RAMP is widely applicable to terrestrial and non-marine aquatic species. It can be applied to multiple unique target regions, ranging in scope from all North America to individual States or Provinces. The new features of RAMP v5 provide managers with information to evaluate how climate change may impact a species' risk of establishment or persistence in their area while also accounting for the inherent uncertainty involved in future climate predictions. This information is useful for the development of invasive species watchlists and in risk and feasibility assessment of response and control options.

Nonlinearities in Assisted Succession to Suppress Reed Canarygrass: A 16-Year Restoration Experiment

*Kattia Palacio-Lopez[1,2], **Stephen Hovick[1]**, Kali Mattingly[1,3], Leah Weston[1], Nathaniel Hofford[1], Logan Finley[1], Aaron Tayal[1], and James Reinartz[4]*

[1]The Ohio State University, Columbus, OH, USA
[2]University of Houston-Downtown, Houston, TX, USA
[3]SpecPro Professional Services Contract to the U.S. Environmental Protection Agency, Duluth, Minnesota USA
[4]University of Wisconsin-Milwaukee

Assisted succession could enable long-term restoration where successional trajectories stall due to competition from invasive plants. Many invasives are shade-intolerant, therefore interventions reducing light availability should suppress invasion and re-establish successional processes. However, given how ubiquitous nonlinearities are in ecology, restoration success also depends on identifying critical system thresholds, e.g., invader abundances below which regeneration of desired species is possible. We report the successful use of assisted succession to restore a swamp forest invaded by *Phalaris arundinacea* (reed canarygrass; hereafter *Phalaris)*.

In 2003, we planted 22 tree and shrub species at high densities into a *Phalaris* near-monoculture after establishing five pre-planting treatments. In 2019 we censused the site to: (1) screen for long-term differences among treatments, (2) evaluate long-term effects of our interventions on community composition, and (3) characterize the critical thresholds that enable invader suppression and restoration success.

Vegetation responses and light availability across our four pre-planting invader removal treatments did not differ. Late fall glyphosate application suppressed *Phalaris* long enough that a dense canopy of native woody species could establish and eventually out-shade it. Overstory tree and shrub densities of 0.071/m^2 suppressed *Phalaris* to 50% cover, but, due to nonlinearities, much higher densities were needed to reduce light availability and thus *Phalaris* cover enough to shift the system from being invader-dominated. Compositional similarities between juvenile woody species and the overstory suggest a long-term restoration success.

Our results show that invasive species management and the restoration of target plant communities can be aided by assisting successional trajectories that have stalled. Establishing a dense canopy of woody species as we did can break the feedback maintaining invader dominance and re-introduce feedback enabling long-term ecosystem recovery. We also illustrate the value of identifying critical thresholds influencing the abundance and impact of key invasive species.

Piscivorous Predators Potential to Prey on the South American Armored Catfish

Diego Juárez-Sánchez[1,2]*, Christina M. Romagosa*[1]

[1]University of Florida, Gainesville, FL, USA

[2]Centro Universitario de Zacapa, Zacapa, Guatemala, Centro América

Can native predators control non-native species populations? Native predators have been identified as potential population control for non-native species by consumptive and non-lethal means. Furthermore, a high diversity of predators has being associated with higer success on the depletion of the populations of non-native or nuisance species. To evaluate these observations in the field, first we need to identify the potential native predators that can depredate on the non-natives. We can do that by evaluating the shared traits that native predators have with predators in the native range of the non-native species. Through a meta-analysis and using the South American armored catfish as a model prey species, I (1) evaluated the relationship between geographic distribution and dietary niche width of vertebrate piscivores in the American continent; (2) identify key traits common to predators that heavily consume armored catfish in its native range; and (3) identify potential predators of the armored catfish in its non-native range.

Impacts of Global Warming on Seed Germination and the Influence of Differential Land Uses on the Occurrence of Invasive *Rosa multiflora* and Native *Rosa setigera* in Cuyahoga County, Ohio

Aruni Kadawatha[1] *and Jean H. Burns*[1]
Case Western Reserve University, Cleveland, OH, USA

The escalating challenges posed by global warming and habitat fragmentation have become critical focal points in ecological research as they may intensify biological invasions, disrupting ecological communities and their resilience. The rapid northward migration of invasive *Rosa multiflora* due to global warming in temperate regions creates a significant threat to ecosystems by replacing native plants. In this study, we investigated both seed germination responses to elevated temperatures and occurrence data in the context of habitat fragmentation. Firstly, hypothesizing that rising temperatures would confer a competitive advantage to invasive species, particularly *R. multiflora*, we conducted a seed germination study along with its native congener, *R. setigera* under two different temperature regimes subjecting to current and projected temperatures for the year 2100 in late spring. Under manipulated late spring temperature reflecting conditions in 2100, *R. multiflora* exhibited earlier germination compared to native *R. setigera*. This temporal advantage may allow *R. multiflora* to capitalize on a priority effect, accessing resources earlier and strengthening its competitive edge, particularly in the face of forthcoming climate changes. In addition, a logistic model was created using both public and research data (GBIF) to analyze occurrence data in Cuyahoga County, Ohio. We hypothesized that the occurrence of *R. multiflora* is facilitated by a higher percentage of fragmented habitat (PFH hereafter). The analysis considered species occurrence relative to the PFH in wetlands, roads, trails, and building areas. Habitat fragmentation was positively correlated with the occurrence of both species ($p<0.05$), however, *R. multiflora*/km^2 was increased by PFH ($r = 0.9523$) to a greater extent than *R. setigera*/km^2 ($r = 0.0289$). We speculate that global warming and habitat fragmentation may interact synergistically to promote *R. multiflora* invasion and native plant displacement, necessitating proactive management strategies.

Non-native Mammals Negatively Affect Native Frugivory in the Eastern Caribbean

***Seokmin Kim[1]**, Fabio Tarazona[1], Max Vollstädt[2], Fernando Gonçalves[2], Emmeli Agerskov Claré[2], Andreas Krogh Norrild[2], Hanna Welzel[2], Tianying Zhang[2], Mark Hulme[3], Christopher Kaiser-Bunbury[4], Benno Simmons[4], Mauro Galetti[5], Bo Dalsgaard[2], Christopher Searcy[1]*

[1]University of Miami, Miami, FL, USA
[2]University of Copenhagen, Copenhagen, Denmark
[3]The University of the West Indies, St. Augustine, Trinidad and Tobago
[4] University of Exeter, Exeter, Devon, England, United Kingdom
[5]São Paulo State University, Rio Claro, Sao Paulo, Brazil

Biotic invasions represent one of the leading threats to natural environments, with the introduction of non-native mammals providing a particular threat to island ecosystems. Specifically, important ecological processes such as frugivory networks have been disrupted by non-native mammals such as rodents, with cascading effects on the broader environment. This study aims to broaden our understanding of the disruptions caused by non-native mammal invasions in the eastern Caribbean - an understudied region within a biologically important hotspot - and to explore how non-native mammals affect plant-frugivore interactions. Using artificial plasticine fruits and camera traps, we directly measured native and non-native plant-frugivore interactions on 13 islands in the eastern Caribbean. We then assessed the relative strength of non-native mammal activity on predicting total plant-frugivore interactions in the context of local, biotic, biogeographic, and socio-economic characteristics. We then explored potential associations with non-native mammal activity through a similar process. Overall, we found that black rats (*Rattus rattus*) made up 77% of all frugivorous interactions detected by camera traps and determined that increased non-native mammal activity led to a significant decline in avian frugivory, presumably through a loss of native bird-fruit interactions. Non-native mammal activity also served as the strongest predictor of total plant-frugivore interactions, greatly outperforming all other predictors. Non-native mammal activity, in turn, was most strongly associated with one within-island factor (proximity to roads) and one between-island factor (proximity of nearest neighboring island). Given the importance of non-native mammal activity in explaining total plant-frugivore interactions and the associated declines in avian frugivory rates, we suggest that non-native mammals are currently dominating frugivory dynamics in the region, with potential negative consequences for native frugivory networks and associated seed dispersal of plants.

Impact of the Invasive Burmese python on the Everglades Food Web

***Shelby LeClare**, Christina Romagosa, and Benjamin Baiser*
Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA

Over the past twenty years, the establishment and subsequent invasion of the Burmese python (*Python molurus bivittatus*) in the Greater Everglades ecosystem has become a topic of concern amongst conservation and restoration efforts in South Florida. The objective of this study is to assess community-wide impacts of the python on the native food-web by attempting to answer three central questions: 1) What niche space is the python occupying within the native food-web? 2) Is there a shift in overall food-web structure and function post-invasion? 3) Are these effects different than we would expect from a random invader? We constructed two quantitative energy flow models (pre- and post-invasion) for the graminoid habitat within Everglades National Park. To address the first two questions, we use ecological network analysis to quantify and compare ecosystem characteristics in each of the two network models. For our third question, we generated randomization-based null models to test if the python's trophic characteristics exhibited different effects than we would expect from a random invader. Here we show that the python exhibits a trophic cascade effect and occupies a novel niche space within the food web, with the Florida panther showing the highest trophic similarity value of 0.40. We found little to no shift in network level indices (e.g., Connectance, Finn Cycling Index, Ascendency) between the pre- and post-invaded networks, however, there was a consistent decrease in carbon flowing through higher trophic levels indicating that the python is redirecting carbon flows from the higher trophic levels. Additionally, results from the null model simulations indicate that python's trophic impacts are different than we would expect from a random invader ($p < 0.001$ for majority of individual and network level indices). In conclusion, this study provides a holistic assessment of the Burmese python invasion on the native community and ecosystem function.

International BEACONS IPM Working Group

Yoosook Lee[1]*, Lindsay P. Campbell*[1]*, Nicole Quinn*[2] *and Carey R. Minteer*[2]
[1]University of Florida – Florida Medical Entomology Laboratory, Vero Beach, FL, USA
[2]University of Florida – Indian River Research and Education Center, Fort Pierce, FL, USA

Anopheles stephensi is a malaria vector native to South Asia. Since its introduction to Djibouti in 2012, it has been detected in 6 other African countries which include Ethiopia, Sudan, Somalia, and Kenya in East Africa, and Ghana and Nigeria in West Africa. In Djibouti, the malaria cases have increased over 2700-fold since 2012 following the introduction of this urban malaria vector. The country has found itself overwhelmed by 58,000-73,000 malaria cases annually in the last three years. This invasive species is a container-breeding mosquito that thrives in populated urban environments unlike native malaria vectors. Transport via maritime cargo and wind will likely expand its invasion to other African countries and other continents. To address this acute public health concern, we are creating an international working group which will facilitate user-driven research and extension with the goal to develop an integrated pest management (IPM) strategy for *An. stephensi* reduction and elimination in Africa. To initiate this working group, we aim to host an in-person stakeholder meeting with representatives from mosquito control operations in multiple countries in Africa and from the US, including delegates from the Pan-Africa Mosquito Control Association, World Health Organization, national-level malaria control programs, regional-level mosquito control operations, agricultural IPM specialists, research scientists, and program officers from funding agencies. The conclusion of this in-person meeting will lead to the organization of task force groups, that will develop need assessment surveys, foster collaborative research and extension, and build infrastructure and resources for stakeholder engagement. Although we focus our initial project on an invasive malaria vector in Africa, our long-term vision is to create an infrastructure that can handle broad One Health issues stemming from invasive species. The network and infrastructure we build will become a foundation to tackle other invasive species issues globally.

A Global Synthesis and Assessment of Free-ranging Domestic Cat Diet

Christopher A. Lepczyk[1], *Jean E. Fantle-Lepczyk*[1], *Kylee D. Dunham*[2,3], *Elsa Bonnaud*[4], *Jocelyn Lindner*[5], *Tim S. Doherty*[6], *John C. Z. Woinarski*[7]

[1]College of Forestry, Wildlife and Environment, Auburn University, Auburn, AL 36849, USA
[2]Department of Biological Sciences, Nunavut Wildlife Cooperative Research Unit, University of Alberta, Edmonton, Canada
[3]Cornell Lab of Ornithology, Cornell University, Ithaca, NY, USA
[4]Ecologie, Systématique et Evolution, Université Paris-Saclay, CNRS, AgroParisTech, Ecologie Systématique Evolution, France
[5]134 Moturata Rd, Taieri Mouth, New Zealand
[6]School of Life and Environmental Sciences, The University of Sydney, Sydney, Australia
[7]Research Institute of the Environment and Livelihoods, Charles Darwin University, Casuarina, Northern Territory, Australia

Free-ranging cats (*Felis catus*) are globally distributed invasive carnivores that markedly impacts biodiversity. To evaluate the potential threat of cats, we developed a comprehensive global assessment of species consumed by cats. We identified 2,084 species eaten by cats, of which 347 (16.65%) are of conservation concern. Islands contain threefold more species of conservation concern eaten by cats than continents do. Birds, reptiles, and mammals constitute ~90% of species consumed, with insects and amphibians being less frequent. Approximately 9% of known birds, 6% of known mammals, and 4% of known reptile species are identified in cat diets. 97% of species consumed are <5 kg in adult body mass, though much larger species are also eaten. The species accumulation curves are not asymptotic, indicating that our estimates are conservative. Our results demonstrate that cats are extreme generalist predators, which is critical for understanding their impact on ecological systems and developing management solutions.

Ensemble Modeling of Invasion Risk under Future Climate and Land Use Change

***Yunpeng Liu**, Matthew B. Thomas*
Invasion Science Research Institute, Entomology and Nematology Department, University of Florida, Gainesville, FL, USA

Biological invasions increasingly threaten global biodiversity and ecosystem functioning. Early detection and eradication of potential invaders are crucial in invasion control, proving more cost-effective than trying to manage species once they become well established. Models can provide useful tools for identifying prospective invasive species and informing monitoring and surveillance. However, previous model predictions have largely overlooked the vital role of native species assemblages in resisting invasion. Further, changes in land-use and climate are increasingly important in the establishment and spread of invasive species, yet our understanding of how global change will affect future invasion threats remains limited. Here, using a species checklist of Florida derived from a previous invasive plant horizon scan, we developed ensemble models on invasion risk assessment. The models predict the spread of invasive species based on the environmental resistance (ER) of native community. ER is measured by multidimensional biological similarities between native communities and the invaded areas, including similarity in species assemblages, phylogenetic and functional diversity, and similarity in assemblages of insect herbivores (natural enemies). We also developed models that consider climatic and geographical similarity between native communities and the native habitats of invasive species. These models are validated by comparing simulated invaded ranges with their current invaded areas in US. The invasion risk map for Florida is then generated based on the model with optimal performance. Finally, we projected future dynamics in invasion risks, by considering different global change scenarios in climate and land use. Our results show that ER models generally outperformed climate/geographical-based models, possibly due to the more comprehensive reflection of the effects of environmental factors on species provided by biological similarities. This study provides a novel framework for predicting the likelihood of non-native species spread and could serve as a valuable tool for decision-making regarding detection of potential invaders in specific regions.

BIO: Yunpeng Liu joined the Invasion Science Research Institute (ISRI) in 2023 as a postdoctoral researcher. He is experienced in biogeography and biodiversity conservation. His previous works focus on large-scale patterns in plant diversity and the evolution of climatic niches at large tempo- spatial scales. His future research will focus on modelling and evaluating the invasion risk of exotic species under future climate change.

Invasion Pathways: The Spread of the New Guinea Flatworm to Outlying Conservation Lands of South Florida

*Samuel H Neely[1], **Lawrence Lopez**[1], Alície Warren[2], Stefan Rhoades[3], David Cook[4], Steve Sparks[5], Eric Gonzalez[1] and Timothy Collins[1]*

[1]Florida International University, Miami, FL, USA
[2]Miami-Dade County Environmentally Endangered Lands, Miami, FL, USA
[3]Florida Department of Environmental Protection, Miami, FL, USA
[4]Florida Fish and Wildlife Conservation Commission, Tallahassee, FL, USA
[5]Big Cypress National Preserve, Ochopee, FL, USA

Invasion pathways encompass a range of mechanisms, both intentional and unintentional, that facilitate the introduction and establishment of non-native organisms in ecosystems. These introductions may disrupt habitats and pose threats to vulnerable species. Many of these introductions are human-mediated, and it has been observed that human population size is highly correlated with non-native species diversity. Of concern in south Florida, introduced species often infiltrate outlying rural and conservation lands, including Everglades National Park (ENP) and Big Cypress National Preserve (BCNP). Invasions in these locations present unique challenges to understanding invasion pathways due to their isolation and limited human impacts. In this study, we document the extent of the invasion of the New Guinea flatworm (*Platydemus manokwari,* NGF) which preys on native tree snails in South Florida. We surveyed populations of non-native flatworms within protected native hardwood hammocks that are embedded in urban, agricultural, nursery-horticultural, and wilderness landscapes throughout south Florida. Outlying wilderness sites in ENP and BCNP ranged from those with many visitors and high traffic to remote sites with few visitors. DNA barcoding and morphology corroborated the presence of NGF and revealed ~12 additional species of non-native flatworms and a non-native ribbon worm (phylum Nemertea). We observed higher abundances of NGF in urban and nursery-horticultural landscapes compared to agricultural and wilderness landscapes. NGF was found in ENP and BCNP. Although less widespread and at lower average densities, this result suggests that these invaders are infiltrating remote areas of conservation lands. Here, we discuss and evaluate different invasion pathways by which predatory flatworms may be reaching these outlying areas. Understanding and mitigating invasion pathways are crucial for preventing the establishment and proliferation of non-native species in remote locations, thereby preserving the ecological integrity of pristine ecosystems and safeguarding biodiversity.

Optimizing Biocontrol in Invasive Species: Agent-Based Model Insights

Yuanming Lu[1]*, Junfei Xia*[2]*, Donald L. DeAngelis*[3] *and Robert D. Holt*[1]

[1]University of Florida, Gainesville, FL, USA
[2]University of Miami, United States, FL, USA
[3]Wetland and Aquatic Research Center, United States Geological Survey (USGS., Davie, FL, USA

In addressing the complex challenge of invasive species management, this study utilizes agent-based modeling to explore effective biocontrol strategies. Our approach is informed by insights into the dynamics of invasive species, particularly focusing on species like *the Melaleuca quinquenervia*, characterized by fast growth, high seed production, and litter that suppresses native seedlings. Central to this research is the development of a strategic model for introducing biocontrol agents in environments dominated by invasive species. We investigate the balance between cost-effectiveness and high success rates in eradicating invasives. The model simulates various ecological scenarios to determine the optimal timing and method for biocontrol agent deployment. Findings from our agent-based simulations suggest that the suppressive effects of invasive litter can significantly influence the spread of invasive trees, challenging biocontrol efforts and potentially leading to irreversible ecological shifts. These insights underscore the importance of timely intervention in the biocontrol process.

This study proposes a framework for biocontrol that incorporates factors such as agent density, dispersal patterns, and environmental influences. Our objective is to establish practical, theoretically grounded strategies for managing invasive species, contributing to ecological balance and economic efficiency.

Enhancing Hydrilla Monitoring in Aquatic Ecosystems: A Comparative Analysis of Atmospheric Correction Algorithms on Sentinel-2 Satellite Data

Ayesha Malligai M.[1], *Amr Abd Elrahman*[1] *and James K. Leary*[2]

[1]GulfCoast Research Center, University of Florida, Plant City, Florida, USA

[2]Center for Aquatic and Invasive Plants, University of Florida, Gainesville, Florida, USA

Hydrilla, an invasive aquatic plant, is infamous for its rapid growth and expansion, demonstrating a tenfold increase in size, ranging from hundreds of manageable acres to dysfunctional tens of thousands of acres within a span of 2-3 years. Notable instances of such expansion have been observed in Lake Yale and Apopka. Between 2019 and 2021, Lake Yale witnessed an 80% coverage of Hydrilla, while Apopka had a 30% coverage, underscoring the profound impact and assertive nature of Hydrilla infestations in these water bodies. Remote sensing plays a crucial role in the efficient and large-scale monitoring of lakes, contributing to effective management and conservation efforts. Sentinel-2's high spatial and spectral resolution imagery proves particularly valuable for lake monitoring. However, accurate atmospheric correction is imperative for extracting dependable information from Sentinel-2 data. In this research, we scrutinize and compare the performance of two widely employed atmospheric correction algorithms, namely Sen2Cor and ACOLITE, for Sentinel-2 data. Our objective is to statistically evaluate their effectiveness using in-situ data, including depth to plant, depth to bottom, biovolume calculations derived from SONAR observations, and corrected reflectance values. The goal is to monitor the presence of Hydrilla. Upon careful evaluation and comparison of the results, it was determined that ACOLITE surpassed Sen2Cor in accurately correcting atmospheric effects, thereby enhancing the reliability of data for effective monitoring of Hydrilla.

The Role of Propagule Pressure, Biotic Resistance, and Nitrogen Loading on Wetland Invasion Dynamics

Jason P. Martina[1]*, Ramiro Ramirez*[2]*, Kenneth J. Elgersma*[3]*, Deborah Goldberg*[4]*, Sean Sharp*[5] *and William S. Currie*[4]

[1]Texas State University, San Marcos, TX, USA
[2]Texas Tech University, Lubbock, TX USA
[3]University of Northern Iowa, Cedar Falls, IA, USA
[4]University of Michigan, Ann Arbor, MI, USA
[5]University of Maryland, College Park, MD, USA

Propagule pressure (PP) and nitrogen (N) availability are recognized to enhance the colonization of introduced plants, while biotic resistance is known to deter invasion. However, the interaction of these three contributing factors is less well known, which is of specific interest in areas where all three vary, such as the coastal wetlands of the Great Lakes. Here, we investigate the interaction of PP and biotic resistance along a N gradient for two invasive species, *Phragmites australis* and *Typha* x *glauca*, using MONDRIAN, an individual-based community-ecosystem model that simulates growth and competition among individual ramets. We explored invasion dynamics into a bareground environment or an established 3-species native community at six levels of PP (1 to 30 rhizomes/m^2) across a N loading gradient (0.86 to 30 gN $m^{-2}yr^{-1}$). We focus on the 1) success rate (the number of successful invasions out of 10 replicate runs), 2) NPP and 3) dominance (proportion of the community biomass) of the invader. While *Phragmites* and *Typha* had similar success rates under low biotic resistance – low success rate (0%) at the lowest N loading and high success rate (100%) at the highest N loading across all PP levels – *Typha*'s success rate was consistently lower under strong biotic resistance regardless of N loading. In contrast, *Phragmites'* success rate was high across biotic resistances. Propagule pressure had much less impact on the success (NPP and dominance) of *Phragmites* compared to *Typh*a. Neither could successfully invade at either biotic resistance at very low N, but *Phragmites* was much more successful at medium to high N loading. While PP only somewhat influenced the success of *Phragmites* overall, when under strong biotic resistance, *Typha* needed high PP to be successful. Our results suggest that invasion is a complex outcome influenced by both external factors (N loading, PP, and competition) and species-specific traits.

The Comparative Functional Response Approach: Linking Application to Ecological Theory

*Pietro Landi, **Michael W. McCoy**, James R. Vonesh*
[1]Stellenbosch University, Stellenbosch, SA
[2]lorida Atlantic University-HBOI, Ft. Pierce, FL USA
[3]Virginia Commonwealth University, Richmond, VA USA

The Comparative Functional Response Approach (CFRA) was proposed in 2014 to provide a practical methodology by which short-term experiments can be used to forecast the longer-term impacts of a potential invading predator. The CFRA makes inferences about potential invader impact based on comparisons of the functional responses of invader and native consumers on native prey in a common experimental venue. Application of the CFRA and derivative approaches have proliferated since it was introduced. Here we examine the conceptual foundations of the CFRA within the context of basic Lotka-Volterra predator-prey theory. Our goals are to assess whether core predictions of the CFRA hold within this framework, to consider the relative importance of background mortality and consumer assimilation efficiency in determining predator impact, and to leverage this conceptual framework to expand the discussion regarding stability and long-term predator and prey dynamics. The CFRA assertion that predators with a higher functional response will have larger impacts on prey holds if all other parameters are equal, but basic theory indicates that predator impacts on prey abundance and stability will depend more on variation in conversion efficiency and background mortality. While examination of the CFRA within this framework highlights limitations about its current application, it also points to potential strengths that are only revealed when a theoretical context is identified, in this case the implications for stability and conceptual links to competition theory.

Scenario Analysis for Invasive Species Management: An App for Evaluating Social-Ecological Networks

***R. W. McCoy**, A. Adhikari, M. Choudhary, B. E. Etherton, R. A. Mouafo-Tchinda, A. I. Plex Sula, J. Robledo, and K. A. Garrett*

UF Plant Pathology Department, Global Food Systems Institute, and Emerging Pathogens Institute

Impact network analysis (INA) is an R package used for analyzing the simultaneous spread of (a) invasive species such as pathogens and (b) information about management options, within a geographic network (https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.13655). Previously the tool was only accessible to those who are proficient in the R programming language. To increase the accessibility of INA, this project introduces ScINArio, a Shiny graphical user interface (GUI) wrapper for INA. This project has made five major improvements. First, ScINArio explicitly names model inputs and organizes them into semantically related groups, to increase parameter comprehensibility. Second, it embeds documentation directly in the GUI. Third, it performs input verification in real-time, and notifies the user of invalid parameters. Fourth, it offers several convenient visualizations of INA inputs and outputs, to add visual intuition to model development. Finally, ScINArio enhances communication about parameters and results between researchers, by using an internal standardized and easily exchangeable file format. These features will extend the range of potential users to increase its utility for invasive species management. We provide illustrations of scINArio use in case studies for plant disease management.

Linking Burmese Python Ecology with Removal Efforts in the Everglades

Melissa A. Miller*[1]*, *Brandon Welty*[1]*, Samantha Smith*[1]*, Amy Yackel Adams*[2]*, Christina M. Romagosa*[3] *Daniel Haro*[3]*, Mark Sandfoss*[2]*, Andrea Currylow*[2]*, Nathan J. Hostetter*[4]*, and Frank J. Mazzotti*[1]

[1]University of Florida, Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, Davie, FL, USA
[2]U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO, USA
[3]University of Florida, Department of Wildlife Ecology and Conservation, Gainesville, FL, USA
[4]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC, USA

The invasive Burmese python (*Python bivittatus*) is established across southern Florida and is implicated in negative impacts to native wildlife. For over a decade, scientists and natural resource managers have investigated python ecology to develop targeted removal and control tools. However, due to their crypsis, pythons have proven extremely difficult to assess, and no tractable abundance estimates have been made. Several successful python removal programs and tracking efforts have been implemented across South Florida. With few exceptions, these programs are focused in accessible areas or high ground habitats containing a mix of hardwood hammock, pinelands, prairie, cypress swamps, and estuaries that constitute only a portion of South Florida wildlands. In addition, most pythons removed from the region are captured while crossing roads or levees transecting vast wild habitats that may be flooded year-round. As such, there is an informational gap regarding python ecology and removal efficacy in the eastern Everglades region, where landscapes primarily consist of sawgrass marsh interspersed with sloughs and tree islands. To address this need, we initiated a collaborative multi-year study to integrate radio-telemetry field techniques and advanced modelling approaches to estimate population-level metrics to inform python removal efforts within the eastern Everglades. Additionally, we initiated a scout snake program, where adult pythons are tracked during the breeding season to lead researchers to mating aggregations, to increase the ability to detect and remove pythons and provide critical information on movements, behaviors, and demographic rates (i.e., survival and reproduction). We present a preliminary assessment of our telemetry dataset, including a dynamic Brownian bridge movement model analysis to assess python spatial ecology and to identify potential temporal and spatial movement pathways. Knowledge of python spatial ecology in the eastern Everglades can inform targeted removal efforts, allowing for more effective management strategies while reducing resources necessary for python control.

Integrating AI and Camera Traps to Detect Invasive Pythons

***Storm A. Miller**, Robert A. McCleery*
University of Florida, Gainesville, FL, USA

Background: Invasive snakes, such as Burmese pythons in the Florida Everglades, pose a significant biological threat to natural systems but can be exceedingly difficult to control because they are rarely detected. Camera traps are widely used to find invasive species; yet, the vast amount of data generated by camera traps, can create backlogs that hamper data processing and analysis. Fortunately, recent advances in artificial intelligence photo-interpretation algorithms may improve the photo analysis workflow, expediting invasive species detection.

Methods: We assess the ability of MegaDetector, an unmodified, open-source artificial intelligence object detection model, to detect snakes, including Burmese pythons, in camera traps images. We used ~1.48 million images from a camera trap study using timelapse photography to detect Burmese Pythons in the Everglades in South Florida for our analysis. We assessed MegaDetector's performance by comparing its detection capabilities and time-savings against manual photo classification.

Results: MegaDetector successfully detected 83.3% (5/6) pythons and maintained high levels of accuracy (98.1%) and specificity (98.3%) when compared to manual review at detecting all snake species. Precision, recall and F1-scores were all low (1.5%, 14.3%, and 2.8% respectively) at detecting all snake species. By integrating MegaDetector into our workflow, we spent 94% less time manually reviewing images (297 hours vs. 18 hours).

Conclusions: Our test of an open-source image detection software underscores its capability to detect an invasive species rapidly and accurately, suggesting that such artificial intelligence models could be pivotal in expediting analysis of extensive camera trap monitoring programs. Implementing these models could greatly reduce bottlenecks and significantly streamline invasive species monitoring, contributing to more effective conservation efforts. However, it is important to approach object detection models with caution, ensuring their validation on a case-by-case basis to maintain accuracy and reliability across diverse ecological contexts.

Laurel Wilt Threatens Global Forests Designing Surveillance and Mitigation Strategies

***Romaric Mouafo Tchinda*[2,3], *A. I Plex Sula*[1,2,3], *B. A Etherton*[1,2,3], *M. Choudhary*[1,2,3], *R. A. Choudhury*[1,2,3,4], *R. Gazis*[1,5], *J. Crane*[5], *K. A. Garrett*[1,2,3]**

[1]Plant Pathology Department, University of Florida, Gainesville, FL, USA
[2]Global Food Systems Institute, University of Florida, Gainesville, FL, USA
[3]Emerging Pathogens Institute, University of Florida, Gainesville, FL, USA
[4]University of Texas, Rio Grande Valley, TX, USA
[5]Tropical Research and Education Center, University of Florida, Homestead, FL, USA

Laurel wilt, caused by the fungus *Harringtonia lauricola*, vectored by ambrosia beetles, is an emerging and devastating disease of avocado and many species in the Lauraceae. Laurel wilt is not yet present in many regions where Lauraceae are abundant, including many important avocado production regions. We evaluated which locations are particularly useful for surveillance and mitigation to slow the future spread of this pathogen. The analysis also provides a warning for areas that are at particular risk, to prepare management strategies. We identify candidate priority locations for early surveillance of laurel wilt by analyzing global wood trade, the landscape connectivity of Lauraceae hosts, and climate suitability for invasion. Analysis of the international wood trade network showed that disease-free countries such as Mexico, Brazil, and Australia have multiple trade links to countries with laurel wilt. Potential epidemic networks were based on maps of host landscape connectivity for Lauraceae in natural areas as well as cultivated avocado. For avocado, locations in southern Mexico and Central America are important candidates for surveillance for laurel wilt. For Lauraceae in natural areas, locations in Amazonia and western Europe are important candidates. Analysis of global climate suitability for laurel wilt identified key locations based on current and future climate, including locations in southern Brazil, southeastern China, and eastern Australia. These results can inform regional, national, and global surveillance and mitigation strategies for laurel wilt.

IPM Working Group: Mosquito BEACONS - Biodiversity Enhancement And Control of Non-native Species – 2024 update

***Valerie T. Nguyen*[1],** *Amely M. Bauer*[1], *Ana L. Romero-Weaver*[1], *Olivia R. Magaletta*[1], *Sangwoo Seok*[1], *Bryan V. Giordano*[1,2], *Benjamin Allen*[3], *Lindsay P. Campbell*[1], *Elmer W. Gray*[4], *Daniel Killingsworth*[5], *Claudia Riegel*[6], *Michael T. Riles*[7], *and Yoosook Lee*[1]

[1]Florida Medical Entomology Laboratory, University of Florida, Vero Beach, FL
[2]Broward Mosquito Control Division, FL
[3]City of Jacksonville Mosquito Control Division, Jacksonville, FL
[4]University of Georgia, Athens, GA
[5]Environmental Security Pest Control, Pensacola, FL
[6]City of New Orleans, New Orleans, LA
[7]Central Life Sciences, Panama City, FL

In support of the NIFA-funded Southern IPM Center, a new IPM working group called Mosquito BEACONS (**B**iodiversity **E**nhancement **A**nd **C**ontrol of **N**on-native **S**pecies) was established in 2021. This working group is the first of its kind to bring together representatives from academia, industry, and government agencies to raise awareness of invasive mosquito species issues, develop targeted and consistent public health messaging, generate training opportunities, and plan integrative research proposals. Collectively, we cover Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Puerto Rico, Texas, and Virginia. These states have serious needs for invasive mosquito surveillance and control. Our members are in a position of leadership in the mosquito control and research profession of each state, and thus have a forum to influence stakeholders for IPM implementation in the corresponding region. Our working group is an integral part of the integrated pest management (IPM) infrastructure to address challenges of invasive mosquito control via promoting multi-state and -county collaborations and sustainable IPM practices. Our past survey targeting mosquito control companies identified training needs as one of the top priorities for improving invasive mosquito surveillance and control in our region. We have provided in-person training workshops for invasive mosquito species identification and data sharing. Our quarterly meetings serve as a channel for regular multi-state communication and collaborations. We continue to develop our online invasive mosquito dashboard for IPM decision support and research. Our working group model can be utilized in other regions or systems to promote invasive species surveillance and awareness and areas of focus, such as engaging with stakeholders involved in invasive species control.

(Some) Success Controlling Ecosystem Damage Caused by Nutria and Hogs in Louisiana's 14,000 km^2 of Coastal Wetlands

John Andrew Nyman
Louisiana State University and Louisiana State University Agricultural Center, Baton Rouge, FL, USA

Louisiana lacks wet and dry seasons, which limit nutria (Myocastor coypus) in their native habitat. Introduced in the 1930s, Louisiana supported ~20 million nutria in the 1950s, which supported an apparently sustainable commercial harvest of 1 to 2 million pelts annually. Pelt harvest plummeted in the 1980s. By 2001, aerial surveys estimated nutria damaged >83,000 acres, which reduces habitat for birds and other mammals, increases wetland susceptibility to erosion during hurricanes, and reduces the ability of wetlands to offset subsidence and sea-level rise via peat accumulation. Data suggested that nutria damaged wetlands only when <400,000 were harvested annually. Efforts to promote markets for pelts, human consumption, and pet consumption failed. Since 2002, wetland restoration funds have been used to encourage harvest ($4/nutria in 2002; $6/nutria in 2023). Harvest areas change annually based on aerial vegetative surveys. Harvest reached 400,000 nutria only once (2009-2010), but damaged acres declined from ~79,000 acres to less than 7,500 acres by 2010. In 2021-2022, damaged acres were estimated at 4,700 acres and 203,824 nutria were harvested. These results depended partly on ideas regarding the amount of nutria harvest needed to prevent habitat damage, and partly on the availability of taxes to (i) replace part of the harvest formerly driven by market forces, (ii) fund vegetation monitoring and (iii) regulate harvest incentive payments.

Feral hogs, uncommon in coastal Louisiana in the 1900s, are now widespread. Hogs damage marsh vegetation and also depredate alligator nests, which entirely supports alligator farming for meat and skins. One study found that aerial gunning during spring can vegetive damage for several years. There is no funding to monitor the extent of hog damage to vegetation or to alligator nests. Control depends on sporadic availability of funding from private landowners and public land managers.

Characterizing Mosquito and Host Communities in Residential and Conservation Areas to Inform Invasive Species Distribution in Florida

Yasmin Ortiz[1,2]*, Simon Casas*[2]*, Eric Caragata*[1,2]*, Lawrence Reeves*[1,2] *and Panpim Thongsripong*[1,2]

[1]University of Florida, Gainesville, FL, USA

[2]Florida Medical Entomology Laboratory, Vero Beach, FL, USA

Over the past decades, human activities have significantly altered landscapes and biodiversity, with serious impacts on the epidemiology of mosquito-borne diseases and global public health. The combined effects of globalization and urbanization may increase the distribution and abundance of invasive vector species. Various mechanisms have been proposed to link increases in human activity with altered dynamics of mosquito-borne disease transmission. Anthropogenic landscape changes can influence the relative abundance of mosquito vectors and hosts, as well as host-vector contact patterns, directly affecting mosquito-borne disease transmission. Our research focuses on characterizing mosquito communities and host-vector contact patterns in conservation and residential areas of Vero Beach, Florida. We hypothesize that conservation lands contain diverse mosquito communities with a lower abundance of invasive vector species such as *Aedes aegypti*. Field collections were conducted weekly to characterize mosquito communities at four study sites representing residential and conservation areas in 2023. Blood meal analysis was performed to determine the host usage of field-collected mosquitoes across study sites. Our results suggest a habitat influence on mosquito communities and the blood host usage of mosquito vectors, with a lower diversity of mosquito communities observed in conservation land. Invasive mosquito species such as *Ae. aegypti* were found in higher proportions in residential areas. Additionally, we documented the first detection of *Ae. scapularis*, another invasive species in Florida, marking the northernmost spread of this species to date. Overall, the results of our research inform how human actions can impact vector-borne disease transmission in Florida by altering invasive vector communities and host-vector contact patterns. This information may lead to better land-use planning policies, improved mosquito-borne disease prevention and control programs, and enhanced public health outcomes.

Curtailing Invasive Species in Gardens through Genetic Sterilization and Genomic Research

***S. Brooks Parrish[1]**, Sandra B. Wilson[2], and Zhanao Deng[1]*

[1]University of Florida, Wimauma, FL, USA

[2]University of Florida, Gainesville, FL, USA

The ornamental horticulture industry is a cornerstone of the US agricultural economy, with states like Florida at the forefront of nursery and greenhouse plant sales. Unfortunately, a subset of these introduced plants have escaped cultivation and become invasive species, jeopardizing delicate ecosystems. In light of this, extensive research has been undertaken to assess the female sterility and landscape functionality of cultivars and hybrids of potential ornamental invasives. Noteworthy species in this context include butterfly bush (*Buddleja* sp.), heavenly bamboo (*Nandina domestica*), Mexican petunia (*Ruellia simplex*), lantana (*Lantana strigocamara*), trailing lantana (*Lantana montevidensis*), porterweed (*Stachytarpheta* sp.), privet (*Ligustrum* sp.), maiden silvergrass (*Miscanthus* sp.), and fountain grass (*Pennisetum* sp.). Fruitless/seedless selections that maintain aesthetic allure have been pinpointed as feasible alternatives to their invasive or potentially invasive analogs. Genetic sterilization is another avenue to produce invasive alternatives as it is being used to produce sterile lantana and porterweed. *Lantana strigocamara* and *Stachytarpheta cayennensis* are invasive species in Florida that escaped cultivation and are hybridizing with native lantana and porterweed species. Through advanced breeding techniques, the UF/IFAS lantana and porterweed breeding program has engineered sterile triploid hybrids that exhibit performance on par with, if not superior to, the invasive types. This sterility not only curtails seed dispersion but also prevents hybridization with indigenous lantana and porterweed species in natural habitats. Furthermore, the program's research on lantana integrates genomics and transcriptomics to pinpoint genes linked with traits that augment invasiveness, such as the production of unreduced female gametes and/or apomictic seeds. This innovative approach, combining classic genetic sterilization techniques with modern genomics, not only offers a sustainable solution to invasive species challenges but also paves the way for future interdisciplinary collaborations in invasion science.

Exploring the Feasibility of Genetic Biocontrol Applications for the Invasive Burmese Python in the Greater Everglades of Florida

Adam Pérez *and Margaret E. Hunter*
U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL, USA

The invasive Burmese Python has been established in south Florida for more than 40 years and occupies tens of thousands of square kilometers of wide-ranging habitats across the greater Everglades, an ecosystem of international significance, where restoration efforts are of high importance. Invasive Burmese Pythons consume various species, directly influencing and altering food webs throughout southern Florida. Research has shown that pythons are responsible for diminishing populations of mammals in the Everglades, such as raccoons, bobcats, gray foxes, and white-tailed deer, which have declined by 85 to 100%. Due to the python's cryptic coloration and behavior, detection, and removal of the species by traditional methods is limited to less than 1%. Without effective detection and control efforts, the invasive python population continues to expand northward and adapt to the colder Florida climate. Due to the extreme environmental impacts to the Florida ecosystems and lack of options for detection and control of Burmese Pythons, all alternative options should be explored for control of this invasive species.

The scale and severity of the impact of invasive pythons indicates that the investigation of innovative techniques for alternative management methods is prudent in order to determine feasibility and to assess public and organizational acceptance. Genetic tools do not rely exclusively on human detection, which is currently the only effective way to remove pythons from the landscape. Preliminary studies focused on target selection and genetic manipulation trials in cultured Burmese Python cells are underway. These are aimed to address pertinent knowledge gaps and develop a shareholder communication framework to support invasive python management. Furthermore, while pythons are the driver, this framework could potentially be used to control other invasive species. This presentation will improve our understanding and knowledge in the field of genetic biocontrol for invasive species.

Extension Webinars Training First Detectors on Early Detection & Identification of Invasive Species–

***Morgan Pinkerton*[1]*, and Amanda Hodges*[2]**

[1]University of Florida/Institute of Food and Agricultural Sciences, Extension Seminole County, Sanford, FL, USA
[2]University of Florida, Entomology and Nematology Department, Gainesville, FL USA

Invasive species pose significant threats including economic losses in agriculture and horticulture, decreased biodiversity, human and animal health hazards, disruption of native ecosystems and more. A recent study suggested that the U.S. loses around $1.2 trillion annually due to invasive species. Florida is a high-risk state for the introduction and establishment of invasive species due to the state's diversity of agricultural commodities, mild winters, large number of international deep-water ports and airports, and highly desirable tourism operations. Research demonstrates that farmers, green industry professionals, and the public play an important role in early detection of invasive species, but awareness is critical to developing strong volunteer-based networks. UF/IFAS Extension Seminole County partnered with the Florida First Detector Program to host a state-wide webinar series on invasive species. Bi-weekly cooperator meetings with regulatory agencies guided creation of agendas targeting diverse audiences of farmers, landscapers, homeowners, and more. Webinars were designed for both professional and public audiences to increase knowledge on invasive species, including identification and management on species of concern to Florida. Beginning September 2022, we offered one-hour, lunch time webinars on the first Friday of every month and had 828 participants in the first year. Each month highlighted a different pest groups or commodities including topics such as invasive fruit flies, scale insects, snails, palm pests, vegetable pests and more. Continuing Education Units (CEUs) were offered to draw in diverse professional audiences. Recap blogs and webinar recordings were also shared broadly after webinars reaching over 2,950 views in the first year. Post-reflective surveys were utilized to measure knowledge gain and the intent to adopt practices learned. Six-month follow-up surveys evaluated behavior implementation over time. Results, successes, and challenges of the first year of First Fridays with Florida First Detector will be presented.

Proactive Biosecurity Priorities Revealed by the Global Biogeography of 1000 Plant Pathogens

***Aaron I. Plex Sulá[1,2]**, Beatriz de Toledo Franceschi[1], Romaric Armel Mouafo Tchinda[1,2] and Karen A. Garrett[1,2]*

[1]Plant Pathology Department, University of Florida, Gainesville, FL, USA

[2]Global Food Systems Institute, University of Florida, Gainesville, FL USA

The unprecedented global invasion of plant pathogens threatens the sustainability of human civilization, yet geographic prioritization in proactive plant biosecurity efforts remains largely unresolved. In response to this multifaceted problem, we identified priority locations based on geographic risk assessments of pathogen invasion through global host landscapes and trade networks for twelve crops key to sustainability. Our analysis indicates a high risk for pathogen spread if biosecurity practices are insufficient in areas with, or connected to, large crop host populations, and in countries with high imports or functioning as trade intermediaries. These risk hotspots are candidate priority locations for proactive targeting of pathogen invasion surveillance.

We then compiled a global reference dataset to quantitatively analyze the geographic distribution of over 1000 pathogen species affecting the twelve crops. Pathogen richness and beta diversity – which tend to group geographically into species-rich hotspots and distinct “epidemiological regions” – are multicausal phenomena. We find strong support for the “species-area” hypothesis, in which pathogen richness peaks in countries with large cropland extent, and little support for environmental filtering. Globally, the structure of host landscape networks predicted these two indices of pathogen diversity.

We also provide evidence global croplands have experienced an exponential increase in new disease epidemics caused by these pathogen species in the last two centuries. Yet, there is no sign of saturation in the accumulation curve of new disease epidemics. A substantially higher proportion of infectious disease epidemics were first reported outside the crops’ native geographic range than elsewhere, scanning a fingerprint from human-driven crop host expansion.

These previously unquantified crop-specific findings collectively provide new ecological perspectives on global pathogen communities and highlight the critical role of human drivers in pathogen invasion success. Integrating these patterns of pathogen invasion in plant health plans could strengthen global epidemic surveillance and mitigation strategies.

Confronting Aquatic Invaders: Assessing Public Perceptions and Willingness to Pay to Control Hydrilla in Florida

Abhishek Rajan[1]*, Olesya Savchenko*[1]*, Candice Prince*[2] *and James Leary*[2]

[1]Food and Resource Economics Department, University of Florida, Gainesville, FL, USA

[2]Agronomy Department, University of Florida, Gainesville, FL, USA

Aquatic invasive plants threaten aquatic ecosystems worldwide. Present in 29 U.S. states, hydrilla (*Hydrilla verticillata*) is considered the most difficult-to-control aquatic invasive plant. Florida is one of the most severely impacted states by hydrilla infestation. Despite large spending, hydrilla management in Florida has been contentious due to varying motivations and economic considerations of different stakeholders. While herbicides are standard for hydrilla control, concerns arise over their environmental impacts. Many anglers and waterfowl hunters value hydrilla habitat for sport fish and game birds' habitat, and they tend to oppose herbicide use. Whereas recreational boaters and property owners prefer the elimination of hydrilla and may be less opposed to herbicides. Understanding these diverse preferences is crucial for effective hydrilla policy.

Our study, the first of its kind, uses a discrete choice experiment to evaluate Florida residents' preferences and willingness to pay (WTP) for different hydrilla management methods. The choice experiment survey presented respondents with a series of hydrilla management scenarios, characterized by a combination of management methods, cost, impact on non-target species, efficacy, and hydrilla coverage levels. The survey also tests if the source of information about hydrilla management (e.g., FWC, University of Florida scientists, newspapers, or state government) affects participants' preferences. The survey elicited 3,069 responses from Florida residents.

Findings indicate the respondents have the highest WTP for a combined mechanical harvesting and herbicide strategy. The study finds substantial heterogeneity in preferences and WTP for hydrilla management across different stakeholders such as visitors, non-visitors, fishing license holders, and environmentally conscious respondents. We also find that providing information about hydrilla management from scientific sources has a significant impact on respondents' willingness to pay than any other sources. This research underscores the importance of stakeholder perspectives in shaping effective hydrilla management policies in Florida.

Don't Move a Mussel: Targeting to Prevent Dreissenid Spread in the Missouri River Basin

Joseph Raymond[1]*, Lucas S Bair*[2]*, Timothy D. Counihan*[2]*, Wesley M Daniel*[2]*, Sofie Duntugan*[2]*, Matthew E Neilson*[2]*, and Michael Springborn*[3]

[1] Agricultural and Resource Economics, University of California, Davis
[2] United States Geological Survey
[3] Environmental Science and Policy, University of California, Davis

The spread of non-native freshwater mussels in North America is a growing threat that has already resulted in substantial ecological and economic damage to infested areas. One of the primary vectors by which invasive mussels spread is watercraft that are transported between waterbodies over land. Management efforts such as watercraft inspection and detection programs can help limit this type of spread, but optimizing the effectiveness of these programs under limited resources is complicated by the many factors that contribute to invasion risk. There is limited research that considers the heterogeneous impact of protection efforts across different regions and water bodies. This information is important for program managers because it can highlight regions that will benefit the most from protection efforts and easily identify regions that require less effort to protect. To this end, we construct a composite relative risk index (CRR) for watersheds within the Missouri River Basin, a region in the US on the front line of dreissenid spread. We construct the CRR using a model that mirrors an expected value model but uses relative indexing to proxy for various model components. The CRR incorporates a wide array of data sets to account for the direct and indirect damages from a potential infestation along with the risk of an infestation occurring. The results from this process suggest substantial heterogeneity in relative risk across watersheds in the Missouri River Basin and the scope of a manager's jurisdiction can influence the relative importance of watersheds. The CRR index also incorporates user-defined weights for specific parameters, enabling users to tailor the importance of various factors to their specific case. Our work features an accompanying web tool that allows users to view the CRR results and adjust parameters to see how they impact the value of the CRR in various watersheds.

Changes in Soil Microbial Diversity and Community Composition Across a Pine Invasion Gradient

Benjamin Reimer[1]*, Kaile Zhang*[1]*, Ko-Hsuan Chen*[1]*, Rytas Vilgalys*[2]*, Jason Hoeksema*[3]*, Jonathan Plett*[4]*, Ian Anderson*[4]*, Jeff Powell*[4]*, Alejandro Rojas*[5]*, Hui-ling Liao*[1]

[1]University of Florida, Gainesville, FL, USA
[2]Duke University, Durham, NC, USA
[3]The University of Mississippi, Oxford, MS, USA
[4]Western Sydney University, Penrith, Australia
[5]University of Arkansas, Fayeteville, AR, USA

The historic importation of *Pinus radiata* and associated microbial symbionts from California to Australia in the 19th century has had profound effects on the indigenous Eucalyptus ecosystems. However, the long-term impacts on soil microbiome structure and dynamics in these invaded habitats have yet to be fully explored. To bridge this knowledge gap, we collected soil samples from native *P. radiata* forests in Cambria, Monterey, and Swanton in California, USA, and from four forest types in both Belanglo and Jelonan, Australia which represent a conceptual gradient of pine invasion. These forest types include *P. radiata* plantation interior, the plantation forest edge, the pine invasion front into a native Eucalyptus forest, and the native Eucalyptus forest. We used amplicon sequencing techniques targeting 16S and ITS regions of the ribosomal RNA to profile fungal and bacterial soil communities respectively. Our findings reveal that native *P. radiata* forests had significantly higher bacterial alpha diversity than those in the Australian forests, with *P. radiata* plantation interior showing significantly greater bacterial alpha diversity than the pine plantation forest edge. However, there was no significant difference in fungal alpha diversity between forest types. Both forest type and geographic location significantly influenced both bacterial and fungal community composition, with forest type being the more dominant factor. Notably, soil bacterial communities in native *P. radiata* exhibited significant differences from those in Australian forests, particularly within the *P. radiata* plantation interiors, which harbored significantly distinct bacterial communities compared to the other three forest types. By contrast, soil fungal communities varied significantly across all forest types. Our LEfSe analysis pinpointed 54 bacterial biomarkers at the genus level, with the majority (44 genera) found in native *P. radiata*, while only 20 fungal biomarkers were identified. This suggests that bacterial taxa displayed a higher sensitivity to ecological changes induced by pine invasion.

A Retrospective Analysis of Research on Plant-invaded Wetlands: Science and Practice for Restoration

Carrie Reinhardt Adams[1]*, Karin Kettenring*[2]*, Stephen Hovick*[3] *and Neil O. Anderson*[4]

[1]University of Florida, Gainesville, FL, USA
[2]Utah State University, Logan, UT, USA
[3]Ohio State University, Columbus, OH, USA
[4]University of Minnesota, St. Paul, MN, USA

Wetlands provide critical ecosystem services. Yet, wetlands are drained, filled, dredged, and otherwise altered by humans, all of which contribute to their high susceptibility to plant invasions. The provisioning of ecosystem services is greatly reduced in invaded wetlands. Given the disproportionately large amount of resources spent controlling invasive plants in existing wetlands, a fundamental shift must occur in how we approach restoration of these systems. We performed a "state-of-the-art review" and drew from discussions surrounding an international conference symposium to 1) detail both broad and specific steps for improving management of plant-invaded wetlands and link them to the constraints they address, 2) document our progress on identifying mechanisms and impacts of wetland plant invasions, and 3) link ecological principles to both removal of invasive plants and restoration of native wetland plant communities.

Our review identified solutions that can be used by individual managers to chart a path forward when needing to pivot from more familiar management actions to increase efficiency. It also yielded a shared vocabulary for considering and selecting the most appropriate solution for a given set of constraints. We prioritize wetland plant invasions research, presenting insights from this review aimed at inspiring future studies on key uncertainties regarding the relative impacts of wetland vs. upland invaders and the relative importance for the success of wetland vs. upland invaders of phenotypic plasticity, population genetic diversity, enemy release, and anthropogenic disturbances . Finally, we highlight the evolution of ecological principles that have been applied to invasive plant management in wetlands and the potential improvements in restoration of native plant communities that will likely result from similar approaches.

Developing Aerial Surveillance Methods for Identifying Water Hyacinth on Lake Lochloosa in Florida

***Amber Riner**, Jonathan Glueckert, Nathan Pals, Ayesha Malligai, Amr Abd-Elrahman, James Leary*
University of Florida, Gainesville, FL, USA

Water Hyacinth (*Eichhornia crassipes* [Mart.] Solms) is an invasive, free-floating plant that has been managed in Florida for over a century. It is currently under statewide maintenance control to prevent small incipients from becoming large infestations. This requires an intense use of resources dedicated to monitoring and treatment efforts over large aquatic systems. This plant can migrate over long distances, colonize new areas and blend into native pad communities, making it difficult for an applicator to locate from a boat. The advent of small unmanned aerial systems (UAS) advances the opportunity for integrating aerial surveillance into the maintenance control of hyacinth. Affordable UAS outfitted with optical sensors and automated flight planning can cover large areas with high resolution imagery that is able to discriminate hyacinth from other species. We are testing this utility on Lake Lochloosa (2400 ha) with line point intercept missions capturing images from a nadir position at 1 cm resolution along transects that follow the littoral shoreline. These missions are highly efficient, e.g., covering over 20 km and capturing over 900 images in less than 2 hours on the water. Each image can be manually scored with a presence/absence classification by an experienced analyst in less than 60 seconds and displayed in GIS for interpretation. To make this process even more efficient, we are integrating convolutional neural networks to automate the detection of hyacinth. These technologies are accessible and user-friendly to practitioners with basic technical skills used in invasive plant management and their adoption will greatly enhance intelligence that goes into management decisions for optimizing effort and resources.

RGB Vegetation Indices for Remotely Monitoring Herbicide Injury in Water Hyacinth

***Amber Riner*[1], *Jonathan Glueckert*[1], *Corrinna Villequez*[1] , *Mike Durham*[2], *James Leary*[1], *Amr Abd-Elrahman*[2], *Benjamin Sperry*[2]**

[1]University of Florida, Gainesville, FL, USA

[2]United States Army Corps of Engineers, Gainesville, FL USA

Water hyacinth (hyacinth) is a free floating, invasive plant that is proactively managed in Florida due to its negative impacts on native wildlife, navigability, and flood control. Herbicides are commonly utilized to manage hyacinth, and chlorosis and necrosis are used as indicators of treatment efficacy in the field. Treatments with fast-acting, contact herbicides are often easier to monitor even though some slower-acting, systemic herbicides may provide comparable or increased control. The focus of this study is to identify vegetation indices (VIs) and establish symptomology profiles to remotely monitor various herbicide treatments. There will be 2 different runs of this experiment, and the duration of each run will be 6 weeks. The treatment design has 6 different active ingredients to be applied at two different rates. Imagery of the study area will be captured in the afternoon and evening across 4 different altitudes once a week by an Unmanned Aerial System equipped with an RGB camera. VIs extracted from this imagery will be analyzed along with visual phytotoxicity ratings and dry biomass data. Identifying vegetation indices that can detect herbicide injury more reliably than the human eye, will improve monitoring hyacinth herbicide treatments and increase the usability of slower acting, systemic herbicides.

Invasive Pathogen Threatens Colombian Bananas: Role of Host Connectivity, Trade, and Human Movement

***Jacobo Robledo*[123], *Sydney Barker*[123], *Neha Kallamvalli*[123], *David McDermott*[123], *Monica Betancourt*[4], *Karen A. Garrett*[123]**

[1]Plant Pathology Department, University of Florida, Gainesville, USA
[2]Global Food Systems Institute, University of Florida, Gainesville, USA
[3]Emerging Pathogens Institute, University of Florida, Gainesville, USA
[4]Centro de investigación Tibaitatá - AGROSAVIA, Bogotá, Colombia

Colombia, the fourth largest global exporter of bananas and plantains, confronts critical challenges from invasive pathogens, especially *Fusarium oxysporum* f.sp. *cubense* Tropical Race 4. Bananas and plantains also serve as dietary staples domestically, underpinning national food security. We employed a rapid risk assessment method (garrettlab.com/r2m), integrating economic, social, and environmental variables to assess the sustainability and vulnerability of these crops under pathogen threat. We evaluated the connectivity of banana and plantain landscapes within Colombia and its neighboring countries and analyzed networks formed through trade of planting materials and services, movement of personnel, and migration, with a focus on formal and informal trade dynamics. Based on the cropland connectivity, distinct regions of potential spread were identified. In the north Pacific coast of Colombia, pathogen dispersal potential is predominantly influenced by connectivity within Colombia. In contrast, in the central, eastern, and northern regions, connectivity with neighboring countries elevates the risk of pathogen spread. A network of trade and movement of plant materials was also reported in expert knowledge elicitation. Banana trade is reportedly concentrated in just four departments, dominated by formal channels, whereas plantain trade is characterized by an extensive, informal network spread nationwide, with critical hubs in central regions. Movement of agricultural personnel generally originates from peripheral areas towards central regions, while there are extensive service networks connecting Antioquia, the foremost banana producer, with regions in Asia, Europe, and the Americas. Our study underscores the necessity of region-specific international surveillance strategies, particularly in areas with heightened risk due to cross-border connectivity. Also, the formalization and regulation of plantain trade is pivotal in mitigating risks inherent to the extensive informal network. Furthermore, implementing stringent biosecurity measures is crucial, both to manage internal personnel movement and to address Antioquia’s global connections, thereby mitigating the risk of invasive pathogens in Colombia's banana industry.

Prey Species Composition, Richness, and Diversity of Burmese Python Diet in Florida

***Christina M. Romagosa*[1]** *Benjamin Baiser*[1], Frank J. Mazzotti[2], Ray W. Snow[3,4], Ian Bartoszek[5], Carla J. Dove[6], Antonio Diego Juárez-Sánchez[1], Eric Suarez[1,7], Michael R. Rochford[2], Jillian M. Josimovich[8,11], Amy A. Yackel Adams[8], Michael S. Cherkiss[9], Jacquelyn Guzy[9], Bryan G. Falk[8,10], Jeremy Dixon[12], Mark Sandfoss[8], Andrea F. Currylow[8], Kristen M. Hart[9], Robert N. Reed[8,13]

[1]University of Florida, Dept. of Wildlife Ecology and Conservation, Gainesville, FL
[2]University of Florida, Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, Davie, Florida
[3]National Park Service, Everglades National Park, Homestead, Florida
[4]Retired
[5]Conservancy of Southwest Florida, Naples, Florida
[6]Feather Identification Lab, Smithsonian Institution, Washington, DC
[7]Florida Fish and Wildlife Conservation Commission, West Palm Beach, Florida
[8]U.S. Geological Survey, Wetland and Aquatic Research Center, Davie, Florida
[9]U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO
[10]National Park Service, Everglades and Dry Tortugas National Parks, Homestead, Florida
[11]U.S. Fish and Wildlife Service, Avon Park, Florida
[12]U.S. Fish and Wildlife Service, Crocodile Lake National Wildlife Refuge
[13]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, Hawaii

Invasive species impacts are a high-priority when planning the restoration and conservation of the Greater Everglades Ecosystem. Impacts have ranged from clogging waterways to altering food webs.

The Burmese python, an invasive predator that has invaded the region, consumes a diverse array of vertebrate prey across its range in southern Florida. Pythons have caused direct and indirect effects on trophic structure, the extent of which depends on how long the snakes have been present in a particular locale. There remain several unanswered questions about spatial, temporal, and/or size-related shifts in their prey species composition. Using more than 1700 necropsied pythons across south Florida, we assess how diet composition and prey richness are affected by python size and geographic region. Python diet data were subdivided into regions that reflect the expansion of the range from the southernmost Everglades, north to Water Conservation Area 3A, and west to Collier County. Since snake species often undergo ontogenetic shifts in diet related to gape limitations, we also defined six size classes. We estimated species richness through rarefaction-based species accumulation curves across the region. We used Bray-Curtis dissimilarity matrices to evaluate turnover and nestedness in the beta diversity of python diet among subregions and python size class. The estimated species accumulation curves did not reach an asymptote, suggesting that the number of prey species consumed by pythons will continue to increase, but this result may also be driven by data sparsity in prey types. Diet differed significantly across size classes, and both turnover and nestedness contributed to those differences. Continued efforts to characterize the python diet in the context of classic biodiversity measures such as species richness and composition, can create food web networks to assess energy and biomass flows to inform ecosystem resilience in the Greater Everglades.

Spatial Ecology of Juvenile Burmese Pythons in Big Cypress National Preserve, FL, USA

***Mark R. Sandfoss[1]**, Amanda M. Kissel[2], Sarah R. Sherburne[1], Jacquelyn C. Guzy[3], Lisa M. McBride[1], Gretchen Anderson[1], Jose Torres[3], Christina M. Romagosa[4], Andrea F. Currylow[1], Matthew F. McCollister[5], Kristen M. Hart[3], and Amy A. Yackel Adams[2]*

[1]U.S. Geological Survey, Fort Collins Science Center, South Florida Field Station Everglades NP, Homestead, FL USA
[2]U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO USA
[3]U.S. Geological Survey, Wetland Aquatic Research Center, Davie, FL USA
[4]University of Florida, Department of Wildlife Ecology and Conservation, Gainesville FL USA
[5]National Park Service, Big Cypress National Preserve, Ochopee, FL USA

Understanding the spatial ecology of an invasive species is critical for designing effective control programs, particularly for wide-ranging, cryptic animals. The range expansion of invasive species can be heavily influenced by the behavior of individuals at the outer edges of the established population and incursions into new areas are often led by dispersing juveniles. Dispersal behavior (i.e., the unidirectional movements of individuals from their birth site to their breeding site) plays a prominent role in defining invasion dynamics. In South Florida, Burmese pythons (*Python bivittatus*) are an invasive species that disrupt ecosystems and have the potential to expand their range beyond Florida. Control of invasive python populations is hindered by limited information on dispersal behavior and habitat associations, especially within the younger age classes. We captured juvenile pythons from 8 nests that were naturally laid between 2021 and 2023 in Big Cypress National Preserve. Juveniles were surgically implanted with radio-tags, released at their original capture location, and their movements tracked on a weekly basis until mortality occurred. Preliminary results indicate juvenile movement patterns are random and unidirectional which suggests that the dispersal potential of invasive pythons is high.

Changing Human Perceptions of Introduced Hippos in Colombia, 2017-2023

David Santamaria-Castiblanco[1], *German Jimenez*[2], *Amanda Subalusky*[3], *Ana A. Rojas*[1], *Laura Nova-Leon*[2], *Juan Reatiga-Parrish*[2], *Sebastian Garcia*[4], *Suresh A. Sethi*[5], *David Echeverri*[6], *and Elizabeth P. Anderson*[1]

[1]Department of Earth and Environment and Institute of Environment, Florida International University, FL, USA
[2]Department of Biology, Pontificia Universidad Javeriana, Bogotá, Colombia
[3]Department of Biology, University of Florida, FL, USA
[4]Grupo Mastozoología, Universidad de Antioquia, Medellín, Colombia
[5]US Geological Survey, New York Cooperative Fish and Wildlife Research Unit, Cornell University, Ithaca, NY, USA
[6]Corporación Autonoma Regional de las Cuencas de los Ríos Negro y Nare (CORNARE), El Santuario, Antioquia, Colombia

Multiple interacting factors influence how people perceive introduced species, including human population demographics, knowledge systems, and characteristics of the species itself. These factors affect the persistence and dispersal of introduced species, yet introduced species management often focuses on ecological factors. We advance understanding of perceptions of an introduced megaherbivore, *Hippopotamus amphibius* (hereafter hippos) in Colombia, and how those perceptions change over time. Four hippos were introduced to the middle Magdalena River Basin (MMRB) of Colombia near the town of Doradal in the 1980s. The population of hippos has subsequently increased to approximately 90-100 individuals in 2023. In 2017, we administered 1099 structured surveys to residents and visitors in the area of the hippos' primary distribution and complemented these surveys with extended interviews with 50 key informants. Our results indicated that human-hippo interactions were a common aspect of life for MMRB residents; one-quarter of residents observed hippos on a daily basis and one-third observed hippos at least once weekly. Second, our results suggest that MMRB residents are habituated to experiencing hippos in their environment. Between 2017-2023, new policies were passed in Colombia to manage introduced hippos and new campaigns were organized by animal-rights activists to advocate for hippos' protection in response to these policies. We examined the effects of these changes on people's perceptions of hippos through repeated surveys and interviews in the MMRB in 2023 and by constructing a contextual timeline. Our results underscore the speed with which social systems respond and adapt to introduced species, which may occur ahead of major ecological effects and constrain management options.

Traits that Facilitate Invasion of Native Habitat

Reid B. Rumelt[1], Leyna R. Stemle[1], Stephanie L. Clements[2], Michelle E. Afkhami[1], Aaron S. David[3], and ***Christopher A. Searcy***[1]

[1]University of Miami, Coral Gables, FL, USA
[2]Tropical Audubon Society, South Miami, FL, USA
[3]Archbold Biological Station, Venus, FL, USA

South Florida is home to more established non-native species than any other continental region in the world. Many of these non-native species are confined to human-altered habitats, and only a subset make inroads into native habitats where they are more likely to impact native species. While there have been many analyses of traits associated with non-native species establishment and geographic spread, there has been little examination of the traits associated with penetration of native habitat. To investigate this question, we downloaded ~300,000 locality records of the 147 most abundant non-native species in South Florida. Using a high-resolution land cover layer, we then determined the fraction of each species' locality records that were from native vs. human-altered habitat. We also collected data on 15 functional traits of each species that have previously been tied to invasive species establishment or spread. Using a model selection approach, we determined which of these traits are most associated with penetration of native habitat. The top model included two traits: wetland tolerance and year of introduction, with wetland species and those introduced longer ago having greater penetration of native habitat. As South Florida's most widespread native habitats are wetlands, this suggests that pre-adaptation to the predominant habitat type is key to invasive species spread. This pattern holds for the non-native species with the greatest penetrance of native habitat in every major taxonomic group: Gray-headed Swamphen, Brown Hoplo, Argentine Black and White Tegu, Feral Pig, and Old World Climbing Fern. The fact that non-native species also increase penetration of native habitat with time since introduction raises concern that South Florida's non-native community has yet to reach an equilibrium and the overall fraction in native habitat will continue to increase.

Investigation of the Genetic Structure and the Insecticide Resistance of Invasive *Aedes* mosquitoes in Hawaii

Sangwoo Seok[1], *Adam Vorsino*[2], *Travis Collier*[3], *Miles McCollum*[1], *Ana L. Romero-Weaver*[1], *Valerie T. Nguyen*[1], *Limb K. Hapairai*[4], *Christopher Jacobsen*[5], *Derrick K. Mathias*[1], *Joanna C. Chiu*[6], *Omar S. Akbari*[7], *and Yoosook Lee*[1]

[1]Florida Medical Entomology Laboratory, University of Florida, Vero Beach, FL, USA
[2]Pacific Islands Fish & Wildlife Office, Honolulu, HI, USA
[3]Independent Scientist, Vero Beach, FL, USA
[4]Pacific Island Health Officers Association, Honolulu, HI, USA
[5]Hawaii Department of Health, Hilo, HI, USA
[6]University of California, Davis, CA, USA
[7]University of California, San Diego, CA, USA

During the last decade, the Pacific Island region, including Hawaii, has suffered from increasing arboviral disease outbreaks. Both, *Aedes aegypti*, and *Aedes albopictus* mosquitoes have been identified as the vectors responsible for dengue, chikungunya, and Zika outbreaks in the region. Control of highly invasive mosquito species like *Ae. aegypti* and *Ae. albopictus* is particularly challenging due to their relatively short flight ranges combined with the potential for long-range dispersal aided by human-mediated traffic. To understand the genetic relationships between *Aedes* mosquitoes of Hawaii and other Pacific Islands and the evolutionary forces shaping the population divergence amongst them, we investigated the population structure of invasive *Aedes* mosquitoes using a whole genome sequencing approach. We sequenced *Aedes* samples from three Pacific Islands, including Hawaii, the Republic of Marshall Islands, and Guam, and then examined the genetic relationship between populations. Subsequently, to explore the possibility of movements of *Aedes* mosquitoes among the Hawaiian Islands, we carried out population genomic analyses for the populations from different Hawaiian Islands. We also conducted CDC bottle bioassays on *Aedes* mosquitoes from two different regions on the Big Island of Hawaii and examined their association with voltage-gated sodium channel (VGSC) mutations. The results of this research will be critical in developing data-driven tools for population dispersal modeling and devising effective control strategies and emergency response plans for future arboviral disease outbreaks in Hawaii.

Comparing Hypoxia Tolerance of Native and Invasive Everglades Fishes in Climate Change Scenarios

***Benjamin Share*[1]*, Aaron M. Hasenei*[2]*, J. Matthew Hoch*[1]*, David W. Kerstetter*[1]

[1]Halmos College of Arts & Sciences, Nova Southeastern University, Dania Beach, FL, USA

[2]College of Science and Engineering, James Cook University, Townsville, QLD, AU

As climate change brings rising water temperatures to freshwater bodies, it has become increasingly important to understand how this will affect ecosystems with established invasive species. Fishes of the family Cichlidae are the most successful invasive fishes in the southern Florida Everglades and have the potential to spread further north with warming water. Invasive water hyacinth *Eichhornia crassipes* is also prevalent in Florida's freshwater bodies and contributes to hypoxic conditions, which may affect species differently based on habitat. If Cichlid tolerance to hypoxia at high temperatures is determined, then predictions of fish survivability and diversity could be made using seasonal dissolved oxygen data. Native Centrarchid fishes of the genus *Lepomis* are morphologically, physiologically, and ecologically similar to Cichlids and can serve as a direct comparison for hypoxia tolerance. Using intermittent-flow respirometry techniques, the maximum metabolic rate, standard metabolic rate, and critical oxygen point were determined for invasive Blue Tilapia *Oreochromis aureus* and native Bluegill *Lepomis macrochirus* at different seasonal temperatures and dissolved oxygen levels based on climate change predictions. To apply these findings to field conditions, dissolved oxygen measurements were also made at three depths beneath *E. crassipes* mats in Lake Okeechobee from April to September. Based on preliminary results, *O. aureus* have a lower critical oxygen point and higher metabolic function, making them likely to utilize habitats physiologically unavailable to *L. macrochirus*. Dissolved oxygen beneath *E. crassipes* mats was found to vary weakly with depth but more significantly by month. Results may help provide new physiological methodology for assessing invasibility risk of exotic fishes.

Using Anglers to Remove Invasive Species, A Summary of the SWFL CISMA Invasive Fish Roundup

Michael J. Sipos[1]*, Mitchell B. Barzowski*[2]
[1]University of Florida IFAS Extension, Naples, FL, USA
[2]Conservation Collier, Naples, FL USA

Florida is home to numerous established populations of nonnative and invasive fish species, many of which can be captured using gears and methods employed by recreational anglers. The Southwest Florida Cooperative Invasive Species Management Area (CISMA) hosts an annual invasive freshwater fish roundup that utilizes effort from recreational anglers and natural resource professional volunteers. This low-cost tournament focuses on removal of invasive species as well as education and alternative uses of collected fish post weigh in. Similar roundups occur statewide however many may not incorporate educational opportunities, evaluation, or further examination of uses of both fish and data collected.

In May of 2023, 91 anglers participated in a 3-day tournament to remove invasive freshwater fish species in a 5-county area. Angling participants harvested 5,639 nonnative fish comprised of 12 species which weighed a total of 2,648 pounds. Educational opportunities were available to interested stakeholders before and during the weigh-in and included a webinar, radio show and day of tabling stations. Catch and location data was collected from each team to submit to United States Geological Survey Nonindigenous Aquatic Species Database. Samples of select species were collected by staff from Florida Gulf Coast University to be analyzed for mercury, PFAS and stable isotopes. Fish that weren't kept by participants were donated as teaching examples or to Naples Compost to be developed into alternative fertilizer.

Post program and 6-month event evaluations were sent to roundup registrants which indicated successes of the program as well as areas where more effort and education could be applied. Through community support from anglers, local businesses, and natural resource professionals this program grows in impact each year and the model could be applied elsewhere in Florida. Analysis of data gathered could fill information gaps which may lead to higher removal rates and alternative products of invasive fish.

Florida Python Control Plan: Creation and Implementation

McKayla M. Spencer *and Sarah Funck*
Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

Burmese pythons (*Python molurus bivittatus*) are an invasive large-bodied species in Florida adversely impacting native species and the Everglades ecosystem. Current range estimates this species is established in south Florida spanning south of Lake Okeechobee to the Upper Keys, an area greater than 4,000 square miles that is owned and managed by an array of agencies, organizations, Tribes, and private landowners. Managing an invasive species problem of this magnitude requires interagency collaboration. The Florida Fish and Wildlife Conservation Commission (FWC) has increased efforts with land managing partners to address this cryptic invasive constrictor that inhabits some of south Florida's most inaccessible terrain. Recent efforts include implementation of python contractor removal programs, coordinating annual Florida Python Challenge® events, removing regulatory barriers for the public to remove nonnative reptiles from public lands, supporting research projects that develop and refine innovative python detection and removal strategies, and coordinating the implementation other components of an interagency Florida Python Control Plan (FPCP). Fifteen federal, state, and local agencies, Tribes, and a non-governmental organization worked together to draft Florida's first FPCP which identifies goals and strategies that land managing partners are using as a resource guide to cooperatively manage and control Burmese pythons. It is through these and other interagency efforts that minimizing impacts of pythons and reducing their numbers across the landscape has improved over time with the expectation that future collaboration will increase the efficacy of python control.

Not so Black & White: Adapting Strategies to Improve Tegu Trapping Efficacy

Shelby Stanley[1]*, Shawn Christopherson*[2]

[1]Florida Fish & Wildlife Conservation Commission, Sunrise, FL, USA

[2]U.S. Fish & Wildlife Service, Vero Beach, FL, USA

Although native to South America, the Argentine black & white tegu (*Salvator merianae*) was introduced to Florida through the exotic pet trade. These large, omnivorous lizards pose a threat to many native ground-nesting animals, including imperiled & protected species such as the American crocodile & Florida gopher tortoise. The Florida Fish & Wildlife Conservation Commission (FWC) currently recognizes four tegu populations in Florida, the most recent being in St. Lucie County.

Since 2016, the FWC has received reports of tegus in the Fort Pierce area (St. Lucie County), following the release of animals from a private entity. Although no tegus were observed during surveys in 2018 by the University of Florida (UF), increased reports in 2019 indicated that these lizards were still present. Subsequently, FWC & U.S. Fish & Wildlife Service (USFWS) staff began a trap loan program for homeowners to remove tegus & in 2021, began planning an additional trapping effort to control the population. In Spring 2022, the FWC, USFW, & UF held an awareness day to increase knowledge & support for removal operations, yielding many additional tegu reports. Areas with high tegu abundance were then identified as trapping locations. Two traplines of 25 traps each were set & checked daily by volunteers. Captured tegus were then humanely killed & measured.
Adjustments have been made throughout the first two years of this project through adaptive management practices. We have utilized heat maps to concentrate traps on tegu “hot spots”, monitored traps with cameras for tegu interactions, & switched to passive-door traps to allow non-target species to escape. Changes between the 2022 & 2023 seasons yielded a 10% increase in tegus caught. By informing future efforts on past successes, this project could serve as a framework for emergent populations of tegus & other nonnative species.

Integrating Social Science and Stable Isotope Analysis with Non-native Game Species Management

Zachary T. Steele[1]*, Karen Caceres*[1]*, Julianne Ritter*[1]*, Austin D. Jameson*[1]*, Will Jensen*[1]*, Claire Penix*[1,2]*, Diane J. Episcopio-Sturgeon*[3]*, Nicole M. Tatman*[4]*, Gilbert J. Villegas*[5]*, Patrick C. Morrow*[5]*, and John P. Whiteman*[1]

[1]Old Dominion University, Norfolk, VA, USA
[2]Ross University School of Veterinary Medicine, Basseterre, Saint Kitts, Saint Kitts and Nevis
[3]University of Florida, Gainesville, FL, USA
[4]New Mexico Department of Game and Fish, Santa Fe, NM, USA
[5]Environmental Stewardship Division, U.S. Army White Sands Missile Range, WSMR, NM, USA

Many non-native game species have been introduced globally to stimulate hunting opportunities. These non-native game species often have economic significance via the sale of hunting tags and members of the public may also develop cultural and personal attachment to these animals from years of interaction. However, the introduction of these big game species also has the potential for unintended negative consequences. These negative consequences include competition with native species for resources, crop damage, the spread of diseases to livestock, and vehicle collisions. As a result, the management of non-native game species is complex because of the positive and negative outcomes from their introduction, and the varying perception of these introductions by numerous stakeholders. As such, the intricate nature of these dynamics necessitates interdisciplinary research to inform the management of these species.

We present a novel interdisciplinary approach to effectively gather information about non-native game species using stable isotope analysis and social science research. While these disciplines differ, both provide a unique, compatible opportunity to gather information without disrupting current management practices. Biological samples (e.g., hair, fecal, blood) from culled non-native game species can be collected by hunters and then distributed by management personnel to labs for affordable stable isotope analysis. Similarly, questionnaires can be distributed to hunters when they purchase or apply for a hunting tag. This approach is resource efficient, prompt, and further emphasizes the conservation aspect of public hunting. We illustrate the effectiveness of this interdisciplinary approach using a case study with an introduced gemsbok (*Oryx gazella*) population in New Mexico. Conducting this case study revealed high participation rates from hunters, quality biological sample collection, and simple logistical requirements. Pairing the findings from both disciplines provided an opportunity to indicate disconnects between public perceptions and the potential negative impacts of this gemsbok population.

Exploring Attachment to Non-traditional Pets Using the Lexington Attachment to Pets Scale (LAPS)

***Diane J. E. Sturgeon*[1]*, Zachary T. Steele*[2]*, Elizabeth F. Pienaar*[3,4]**

[1]Invasion Science Research Institute, Department of Entomology and Nematology, University of Florida, Gainesville, FL, USA
[2]Department of Biological Sciences, Old Dominion University, Norfolk, VA, USA
[3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA, USA
[4]Mammal Research Institute, University of Pretoria, Hatfield, South Africa

It is well documented that one of the major introduction pathways of non-native species is the non-traditional pet trade. However, debate remains about the main factors contributing to an owner deciding to release their non-traditional pet. One argument suggests that intentional non-traditional pet release events are related to a lack of attachment to the animal. The Lexington Attachment to Pets Scale (LAPS) was developed in 1992 to assess pet owner's emotional attachment to their pets, with a recent expansion to include owners of reptiles. However, more research is needed to fully explore this understudied topic across a range of non-traditional pets. The aim of this study was to investigate factors correlated to LAPS among owners of reptiles, amphibians, fish, insects, and arachnids in the United States who own a range in number of non-traditional pets. We obtained 1,280 questionnaires from an online survey of non-traditional pet owners. Overall, we found similar attachment scores to previous studies assessing attachment to non-traditional pets. However, in contrast to previous studies, female non-traditional pet owners in our sample exhibited significantly higher attachment scores than their male counterparts. Owners of 6-20 non-traditional pets exhibited the highest levels of attachment, followed by owners of ≥21 non-traditional pets, with owners of only one non-traditional pet exhibiting the least attachment to their pet. Additionally, pet owners who cared for traditional pets like cats and dogs in addition to non-traditional pets displayed higher attachment scores than individuals who exclusively owned non-traditional pets. Owners who were gifted or inherited their non-traditional pet had lower attachment to their pets relative to those who obtained their non-traditional pets directly. While future research is needed on the link between attachment and likelihood of pet release, the differences in attachment among different types of owners has implications for the design of outreach efforts to mitigate non-traditional pet releases.

Flora Unchecked: Investigating the Consequences of Ornamental Plant Invasions

Carlos Tapia[1]*, Mahadev Bhat*[1]*, Madhugiri Nageswara-Rao*[2]*, Krish Jayachandran*[1]*, Maruthi Bhaskar*[1]

[1]Florida International University, Miami, FL, USA

[2]United States Department of Agriculture, Subtropical Horticultural Research Station, Miami, FL, USA

Invasive species and their adaptability present major challenges to agricultural operations, environment, and economics. Specifically, invasive plants have the ability to out-compete various types of native vegetation, especially with plants cultivated in the horticultural industry. Plant nursing is a diverse and multi-billion dollar industry, with trade networks spanning across the world, with the Netherlands, the United States, and Eastern Africa serving as major nodes of plant transport. Since many ornamental plants originate in exotic environments, combined with the potential for escaping production and distribution nurseries, the establishment of growing operations may further exacerbate any subsequent economic damage, and hinder progress towards the management. Furthermore, some invasive species such as the Castor Plant, Rosary Pea, and the Old-World climbing fern can produce medically-significant toxins, and allelopathic compounds that may inhibit the growth of native plants.

Such an economic, ecological, and public health challenge warrants a thorough investigation into this relatively under-studied aspect of species invasion. In examining the subject plant spread and its invasion mechanisms, we will be using Agent-Based Models to serve as proxies for the real-world invasive growth mechanics. Furthermore, these modeled scenarios will represent how species that are simultaneously toxic, ornamental, and invasive, can escape from their nurseries and perpetuate into the agroecosystems; as well as how various management scenarios could impact the mechanisms of its escape and spread. Findings from this study will have implications in further informing and contributing to the poignant discourse on the role of the ornamental plant trade, as well as best practices to ensure a minimal impact on farmers, landowners, and the pristine environment.

Evaluating the Effectiveness of Baited-Ink Plates for Rat Monitoring in a Montane Rainforest

***Kathryn Temple*[1], *Jean Fantle-Lepczyk*[1], *Christopher Lepczyk*[1], *Lisa Crampton*[2], *Robert Gitzen*[1], *Mari Reeves*[3], *Roy Gilb*[2]**

[1]Auburn University, Auburn, AL

[2]Kaua'i Forest Bird Recovery Project, Hanapepe, HI

[3]U.S. Fish and Wildlife Service, Honolulu, HI

Since human arrival to the Hawaiian Islands, non-native predators have decimated native flora and fauna. In particular, native forest bird populations have suffered due to rat (*Rattus* sp.) depredation. Conservation practitioners have been removing rats and other rodents from ecologically sensitive areas to protect native species. Identifying reliable strategies for assessing the effectiveness of these control efforts is critical, particularly given limited resources for conservation. A common method used for monitoring rodents is baited ink-plates within a tracking tunnel. While this method is widely used, its effectiveness has yet to be evaluated in many ecosystems, including montane rainforests. To evaluate the effectiveness of monitoring rat presence with track plates, we focused on the Alaka'i Plateau on the island of Kaua'i, which is home to several of Hawaii's most critically endangered birds, and where over 300 rat traps are currently in operation. The Alaka'i experiences over 6m of annual rainfall, giving rise to areas of dense vegetation, which may affect how rats encounter and interact with tracking tunnels. We paired 116 Reconyx HyperFire cameras with individual tracking tunnels in the summers of 2022 and 2023 at a site with an ungulate exclusion fence and a site without an ungulate exclusion fence and included areas with and without rat traps. We used a generalized linear model for analysis and found that cameras were 56.54 times more likely to detect rat presence than ink plates regardless of site or rat trap presence. These results suggest that cameras could be a powerful tool for accurately assessing the efficacy of conservation interventions to mitigate the impact of invasive predators on Hawaii's native birds. Further research into the cost efficacy versus the information gained by the two methods could help further refine conservation methods.

A Novel Parakeet-Selective Feeder for Control of Invasive Psittacines

*C. Jane Anderson[1], **Eric A. Tillman[2]**, William P. Bukowski[3] and Steven C. Hess[4], Leonard A. Brennan[1], Page E Klug[5], and Bryan M. Kluever[2]*

[1]Caesar Kleberg Wildlife Research Institute, Texas A&M University – Kingsville, Kingsville, TX, USA
[2]USDA APHIS Wildlife Services, National Wildlife Research Center, Florida Field Station, Gainesville, FL 32641, USA
[3]USDA APHIS Wildlife Services, Lihue, HI, USA
[4]USDA APHIS Wildlife Services, National Wildlife Research Center, Hawai‘‘i Field Station, Hilo, HI, USA
[5]USDA APHIS Wildlife Services, National Wildlife Research Center, North Dakota Field Station, North Dakota State University, Fargo, ND USA

Over 40 species of parrots, members of order Psittaciformes, have established nonnative populations globally. Monk parakeets (*Myiopsitta monachus*) are among the most invasive bird species worldwide. In their introduced range, populations of monk parakeets have caused negative impacts on native species, habitats, economies, and human safety. Lethal population management has been complicated by the intelligence of monk parakeets, as they quickly alter behavior to avoid risks. Further, lethal control programs have been halted due to public controversy, as parakeets are highly charismatic. The contraceptive DiazaCon has been demonstrated to effectively reduce fertility in monk parakeets and other Psittacines. In field applications, chemical control agents (e.g., toxicants and contraceptives) must be delivered in a manner that prohibits access by non-target species. We developed and tested a parakeet-selective feeder. The feeder allows access by parakeets and limits access by non-target bird species by lowering a wire exclusion curtain around the feeder, requiring a zygodactyl toe arrangement to access food. We tested the parakeet-selective feeder in trials with captive and free-ranging monk parakeets and free-ranging non-target species in Florida, USA. Monk parakeets successfully accessed food from the parakeet-selective feeder throughout the study. The mean number of daily feeder uses by non-target species decreased from a high of nearly 16 uses per day when the exclusion curtain was not implemented to <1 use per day when implemented. Our findings suggest the parakeet-selective feeder is a promising tool for delivery of bait treated with chemical control agents to manage monk parakeets and other nonnative parakeet populations, but implementation success will likely vary by target species, location, local faunal diversity, and availability of alternative forage.

What to Expect When You're Expecting the Invasion of the Freshwater Assassin Snail, *Anentome helena*

***Lori Tolley-Jordan**, Tenzing Ingty, and Chris Murdock, Jacob Hinkles, and Kathleen Madden*
Jacksonville State University, Jacksonville, AL, USA

The bumble-bee assassin snail is one of only a few freshwater species in the marine lineage, Neogastropoda, that includes predatory snails such as whelks and cone snails. *Antentome helena* is native to freshwater systems of Malaysia but is now distributed world-wide in the hobbyist, on-line aquarium trade. As these snails are habitat generalists, thrive in water temperatures of 18 degrees to 22 degrees centigrade, and are voracious predators on a wide variety of snails, the imminent invasion of *A. helena* into streams and springs is of a strong concern to conservation biologists. As such, we used a three-pronged approach to detect the invasion and assess the threat of declines or extirpations of native snails in naïve habitats. First, a bioclimatic model including freshwater-specific environmental variables showed that South Florida has a high probability of invasion. However, these models do not include water temperature data for springs that are common throughout Florida and other regions of the USA. As such, eDNA primers based on published sequences of coenzyme oxidase I were developed to encourage resource managers and citizen scientists to collect water samples from areas of conservation concern. Finally, feeding trials of assassin snails with native periwinkles (Pleuroceridae: *Elimia godwini*) are ongoing. With these methods, early detection of the invasion of bumble-bee assassin snails may give resource managers the opportunity to eliminate or suppress populations to prevent population declines of native freshwater snails.

Phenology and Spatial Distribution of the Invasive Species, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) in Florida Citrus Screenhouse Production Systems

***Zahra Torkaman*[1]*, Lauren Diepenbrock*[1]*, and Megan Dewdney*[2]**

[1]University of Florida, Entomology and Nematology Department, UF/IFAS Citrus Research and Education Center, Lake Alfred, Florida
[2]University of Florida, Plant Pathology Department, UF/IFAS Citrus Research and Education Center, Lake Alfred, Florida

Chilli thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae), is an economically important pest of vegetable, fruit, and ornamental crops throughout Asia, Africa, Oceania, the Caribbean, and some parts of South America and is an invasive pest in several US states including Florida. This polyphagous pest can cause direct and indirect damage to various crops, and it has recently become an issue in CUPS (Citrus Under Protective Screen). Chilli thrips are known to have an aggregated distribution and tend to form small areas of high population density termed “hot spots”, and the identification and prediction of these "hot spots" through modeling could enable more targeted management programs. This study aims to determine (1) the seasonal phenology of chilli thrips, and (2) the spatial distribution of chilli thrips in CUPS. The present study examined the seasonal abundance of chilli thrips in citrus under protective cover from February 2022 to February 2023. To monitor the chilli thrips population, the study evaluated three different methods. This included alcohol washes, yellow sticky cards, and tap counts. Results from the first year showed that chilli thrips density increases during late March and early April, as well as September. The number of adult thrips found early in spring captured by sticky cards was significantly higher than the number of thrips observed through alcohol washes.

To date, the spatial distribution study has shown that the population of adult chilli thrips along the edges of the screenhouses was significantly higher than in the center of CUPS. Further research will elucidate if this is due to migration into the screenhouse.

The knowledge generated from this study helps growers in adopting more efficient and resource-effective strategies for pest management in citrus under a protective screen.

Impacts Following Boom-and-Bust Invasion Dynamics: African Jewelfish in the Shark River Slough

Joel Trexler[1,2]*, Matthew R. Pintar*[1]*, Peter Flood*[1,3]*, Jeffrey L. Kline*[4]*, and Nathan Dorn*[1]*,*

[1]Florida International University, Miami, FL, USA
[2]Florida State University, Tallahassee, FL, USA
[3]University of Michigan, Ann Arbor, MI, USA
[4]Everglades National Park, Homestead, FL, USA

Boom-and-bust population dynamics are a long-recognized phenomenon during species invasions. However, few studies document community-level impacts, recovery, and long-term consequence from these ephemeral changes in a dominant species. We used a 25-year dataset of fishes and decapods in the Shark River Slough, Everglades National Park (ENP), to assess potential effects of African Jewelfish (*Hemichromis letourneuxi*) invasion (boom-bust dynamics; 2012–2021) on native species. After accounting for effects of hydrologic variation, several native species declined concurrently with jewelfish booms; both higher jewelfish abundance and jewelfish presence were associated with declines up to 50% of four common small-fish species. Following the bust in jewelfish populations, densities of many species recovered to match predictions based on hydrologic models. To illustrate the impact of African Jewelfish boom, we estimated their impact on Eastern Mosquitofish (*Gambusia holbrooki*) by estimating the spatial range of the invasion and their area-weighted density. At their peak abundance, approximately 50% of Eastern Mosquitofish in Shark River Slough were replaced by African Jewelfish. At the community-level, metrics of community structure (species relative abundance) indicated continuing impacts of the African Jewelfish boom during the bust period because native species recoveries were individualistic and uncoordinated. We documented recovery and resiliency in native species following the population bust of African Jewelfish, but also persistent effects at the community level. Our findings for jewelfish were consistent with some, but not all, findings from experimental mesocosm studies. Future work should delineate the implications of biological invasions on Everglades ecological functions such as providing critical prey resources for apex predators like wading birds during the nesting season.

Spatial Patterns as Long Transients in Submersed-floating Plant Competition with Biocontrol

Linhao Xu[1] *and Donald L. DeAngelis*[2]

[1]Department of Biology, University of Miami, Coral Gables, FL, United States

[2]U. S. Geological Survey, Wetland and Aquatic Research Center, Davie, FL, United States

A cellular automata model was developed and parameterized to test the effectiveness of application of biological control insects to water hyacinth (*Pontederia crassipes*), which is an invasive floating plant species in many parts of the world and outcompetes many submersed native aquatic species in southern Florida. In the model, *P. crassipes* is allowed to compete with Nuttall's waterweed (*Elodea nuttallii*). Model parameters were varied to study effects of plant growth rate, nutrient concentration, and nutrient diffusion rate on the dynamics of the system. In the absence of biocontrol acting on the *P. crassipes*, *E. nuttallii* excluded *P. crassipes* at low concentrations of the limiting nutrient (nitrogen), and the reverse occurred at high nutrient concentrations. At intermediate values, alternative stable states could occur; either *P. crassipes* alone or a mixture of the two species. We found that adding a biocontrol agent, based on the biology of the weevil *Neochetina eichhorniae*, dramatically altered system dynamics. For example, there was initially a rapid reduction of the *P. crassipes*, with evolved over time to regular striped pattern of moving spatially alternating stripes of *P. crassipes* and *E. nuttallii*. This pattern of moving stripes persisted over thousands of days, but in some simulations the pattern was suddenly replaced by an irregular temporally varying pattern that lasted indefinitely. Thus, the striped pattern is an example of a long transient. The irregular spatio-temporal pattern that replaces it appears to be permanent, though that has not yet been established.

Comparative Study Between the Helminth Endoparasite Community of Columbids in South Florida, USA and Eleuthera, Bahamas

Briana Zaffiro[1]*, David Kerstetter*[2]*, Christopher Blanar*[1]

[1]Department of Biological Sciences, Halmos College of Arts and Sciences, Nova Southeastern University, Fort Lauderdale, FL USA

[2]Department of Marine and Environmental Sciences, Halmos College of Arts and Sciences, Nova Southeastern University, Dania Beach, FL USA

Family Columbidae in southeast Florida is a complex of six common native (N) and introduced (I) doves and pigeons. Populations of each species have varied over time, but southeast Florida and the Florida Keys have experienced a recent influx of White-Crowned Pigeons, likely from The Bahamas. To assess the extent to which this influx is contributing to parasite spillover and/or spillback, we examined endoparasite communities in Eurasian Collared Dove (I; *Streptopelia decaocto*, n=31), Rock Dove (I; *Columba livia*, n=26), White-Winged Dove (N; *Zenaida asiatica*, n=5), White-Crowned Pigeon (N; *Patagioenas leucocephala*, n=47), Common Ground Dove (N; *Columbina passerina*, n=11), and Mourning Dove (N; *Zenaida macroura*, n=29). Additional specimens of White-Crowned Pigeon were obtained from Eleuthera, The Bahamas (n=17). The most abundant parasites found were *Ascaridia columbidae, Capillaria* sp., and *Dispharynx nasuta* All three are nematodes; *Ascaridia* and *Capillaria* are directly transmitted but often use earthworms or insects as paratenic hosts, while *Dispharynx* is transmitted via isopods. The observed parasite commities likely reflect foraging behaviors close to the ground in locations where Columbids may commonly excrete. Endoparasite prevalence varies by species, White-Crowned Pigeon hosts from southeast Florida and Eleuthera have similar prevalence and intensity rates. Native Columbids showed lower prevalence and intensity rates than introduced species, raising the possiblility that the latter may potentially contribute to parasite spillover.

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