James C. Kennedy
WATERFOWL &
WETLANDS CENTER
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2025 ANNUAL REPORT

James C. Kennedy
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Message from
THE DIRECTOR

The national landscape has changed drastically in terms of higher education, wetland conservation, and waterfowl management. Changing national policies, funding initiatives, and social norms have all evolved and transformed our way of thinking and operating at an unprecedented rate. Like many lessons in life, we either adapt and change with the times, or we are left behind. Although many of these changes are beyond our control, we can continue to produce sound science and train our students to pursue excellence in all they do. As the James C. Kennedy Waterfowl and Wetlands Conservation Center continues to navigate and adapt, our focus on waterfowl and wetland management issues facing South Carolina and the region, while simultaneously training our students to be good stewards of our natural resources remains constant.

This past year has been another busy one. In addition to my role as the Kennedy Center Director, I have also assumed the role of Director for the Baruch Institute of Coastal Ecology and Forest Science. To help alleviate some of this extra burden, we received permission to hire an Assistant Director for the Kennedy Center and the search is underway. Thanks to our dedicated staff and students, we had a tremendously successful year obtaining external grants and contracts. This type of funding is central to the issues we study, particularly as we face dwindling federal research dollars.

I remain grateful to Mr. Kennedy for his continued support of the James C. Kennedy Waterfowl and Wetlands Conservation Center. I also appreciate the interest that our Dean, Matt Holt, has shown in our programs and research. A special thanks to our Advisory Council for their continued guidance and advocacy. Thank you to our donors and grant providers. Finally, I thank our students and staff for their dedication to waterfowl and wetlands conservation.

I hope you enjoy reading about the science our students are conducting. I am proud of their accomplishments and our progress over the past four years. I look forward to the year ahead as we focus our sights on new discoveries and positive changes for wetland and waterfowl conservation.

Take care,

James T. (Jim) Anderson, Ph.D.

Director, James C. Kennedy Waterfowl and Wetland Center
Director, Belle W. Baruch Institute of Coastal Ecology and Forest Science
James C. Kennedy Endowed Professor of Waterfowl and Wetland Ecology

Summer
INTERNSHIP

Summer
INTERNSHIP

WATER QUALITY IMPACT ON AQUATIC MACROINVERTEBRATES

Allison Healy
Senior, Environmental and Natural Resources
James C. Kennedy Waterfowl & Wetlands Conservation Center
Clemson University Professional Internship and Co-op
Mentor: Scott Binger

My name is Allison Healy, and I am a senior at Clemson University majoring in environmental and natural resources with a concentration in natural resource management and a minor in sustainability. I am studying to learn about sustainability and how to help the environment. I decided to take this internship because I wanted to learn about both field studies and data analysis. I wanted experience in laboratory techniques and data management. I have a lot of interest in wetland ecology and water quality testing. This summer I worked with Scott Binger on the Carolina Bay Ecological Survey project.

I have learned a lot about macroinvertebrate identification and collection. I learned to use a D-net and a DO meter which measures pH, temperature, DO%, conductivity, and salinity. I learned how to take samples in the field and how to preserve them. I learned how to test soil samples for macroinvertebrates. Through identifying macroinvertebrates, I learned which macroinvertebrates imply good water quality. This has been a very good hands-on experience with learning about macroinvertebrates. I have used a simple microscope to identify the family of aquatic macroinvertebrates and magnifying glass to go through soil samples. I have also done a lot of data entries which taught me how to organize data in an easy-to-understand way. I have also learned to use online ArcGIS (Geographic Information System) which can show the percentage of development near each bay. The abundance of development was correlated with the level of pollution. My main task was to research the impact of development on Carolina Bay ecology, specifically macroinvertebrates. Throughout the summer the identification of aquatic macroinvertebrates has shown the water quality of the bays.

This internship has impacted me because it has taught me a lot about how my future will look. I understand my future job will have times when it is very hands-on and physically challenging, and there will be other times when data analysis will take place on a computer in an office. This internship taught me that I will enjoy having a mix of both. In the future I want to be an environmental consultant which would ensure companies comply with environmental laws and regulations to protect the environment from hazards. I believe it would be interesting to eventually work for an engineering or power company to help them stay within the environmental regulations. I think this would be an enjoyable balance between data analysis and field sampling.

Summer

INTERNSHIP

MICROPLASTICS IN THE CROP OF BLUE-WINGED TEAL

Timothy Carroll

Senior, Wildlife and Fisheries Biology

James C. Kennedy Waterfowl & Wetlands Conservation Center

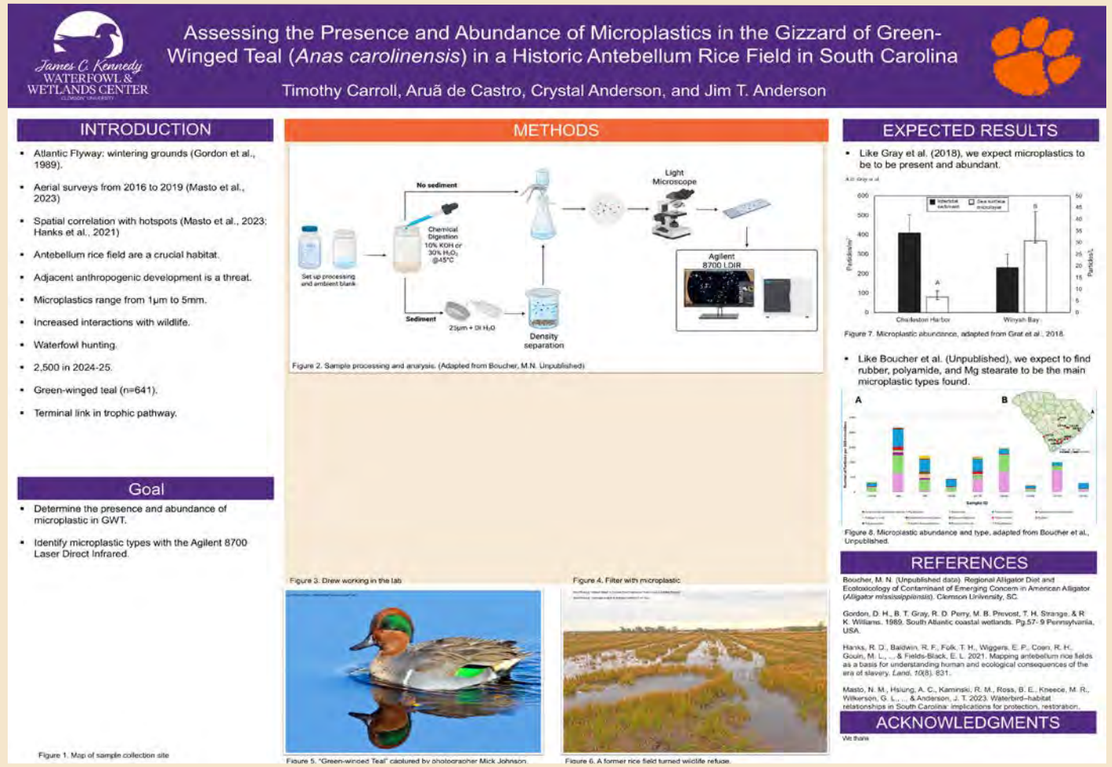
Clemson University Professional Internship and Co-op

Mentor: Aura Yaym de Castro Ferreira

My name is Timothy Carroll, and I am a senior at Clemson University studying Wildlife and Fisheries Biology. I chose this internship to give me insight into my future as a wildlife biologist and what that career might be like during the summer field season. I worked with Crystal Anderson, Keegan Foster, and Aruã de Castro on multiple wildlife projects this summer. The projects included surveys of pollinators, birds, and anurans conducted in various habitats. For example, the anuran and bird surveys were held at different sites within the Carolina Bay wetlands. Within these surveys, we were tasked with identifying the species present based on sight and sound. One of the specific research tasks I was given this summer was to analyze the presence of microplastics within the gizzard of Green-winged Teal (*Anas carolinensis*). This learning experience helped me visualize what the process of building a true research project is and how to analyze results properly. We found an interesting amount of microplastics within the ducks, with plastics such as polyamide and rubber being the most abundant.

Throughout these projects, I learned the importance of working as a team and asking necessary questions to understand all the many new experiences. I learned so much regarding the biology of the three wildlife groups we studied. For example, my wildlife identification skills were put to the test often during the surveys. Some of the equipment I got to use includes weather kestrels, an LDIR machine for microplastics analysis, different pollinator traps, and much more.

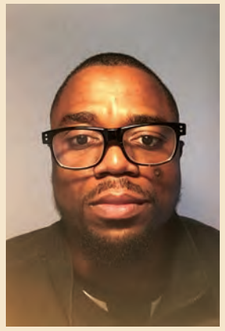
This internship has impacted me positively in many ways. It was great being able to experience many different types of wildlife management in one summer internship. The James C. Kennedy Center was able to help me narrow down which parts of wildlife and wetland biology I enjoy the most, which will help guide me in my future career decisions. After I finish my undergraduate degree at Clemson, I hope to continue using what I have learned from this internship as well as working within the field of wildlife biology. I also hope to pursue graduate school in the future.



Summer
INTERNSHIP

GEOSPATIAL ANALYSIS OF MANAGEMENT IMPACTS ON ECOSYSTEM HEALTH OF SELECTED PRIVATEM HISTORIC RICE PLANTATIONS IN GEORGETOWN COUNTY, USA

Patrick Akinwumi
Ph.D. Student, Computer Science and Software Engineering
James C. Kennedy Waterfowl & Wetlands Conservation Center
Clemson University Professional Internship and Co-op
Mentor: Oluwatobi Emmanuel Olaniyi

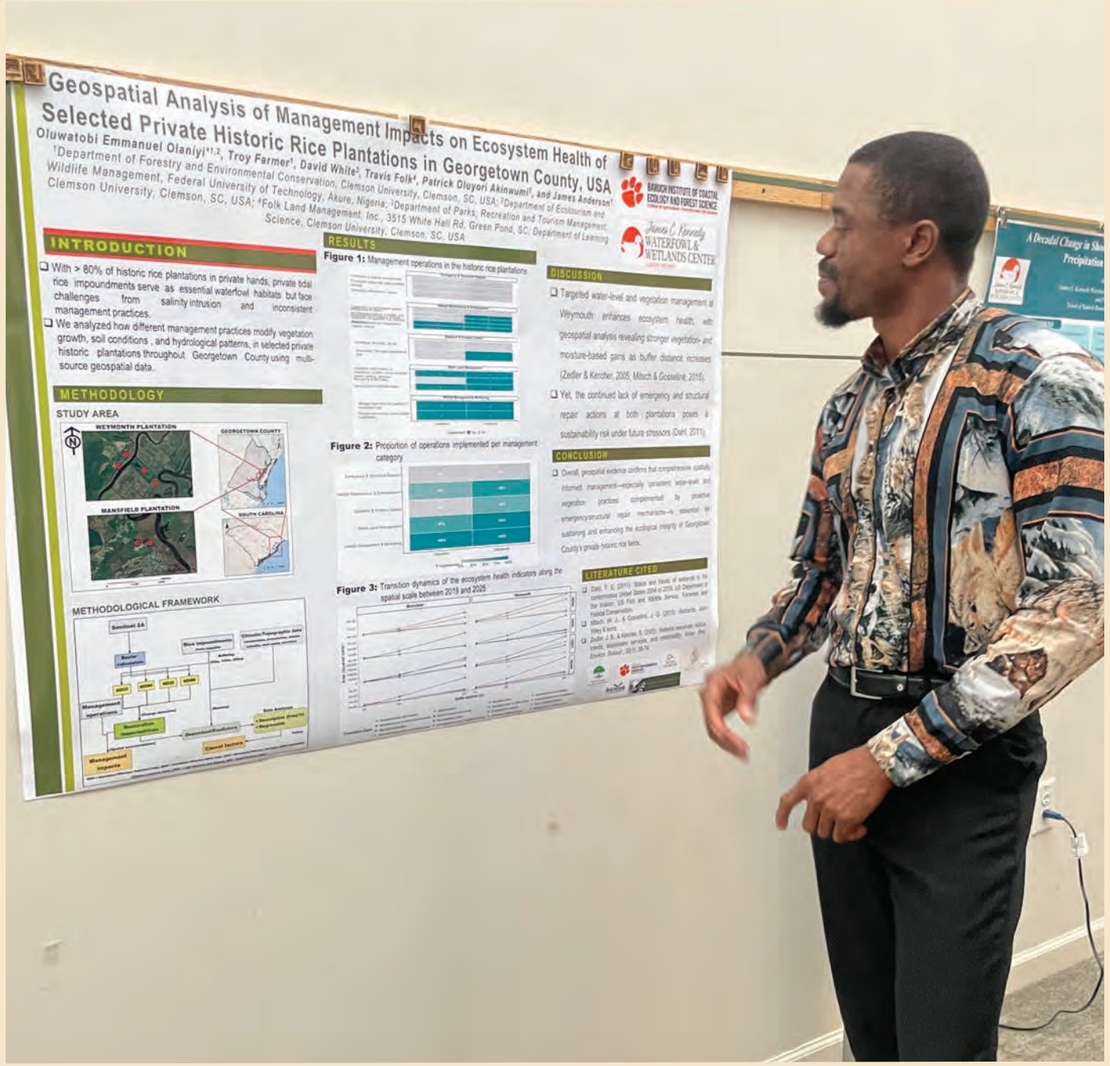


My name is Patrick Akinwumi and as a Ph.D. student in Learning Sciences and a graduate assistant, I specialize in artificial intelligence and machine learning with a focus on amplifying human potential through intelligent systems. My research blends data science, predictive modeling, and applied problem-solving, with a particular interest in how these tools can address real-world challenges.

I chose this internship because it offered the chance to apply my technical expertise to an environmental context. The project's integration of geospatial analysis, ecological management, and field-based inquiry aligned perfectly with my interests. It provided an opportunity not only to work with complex datasets but also to see the practical impact of data-driven decision-making in managing and preserving ecosystems.

Working alongside Oluwatobi Emmanuel Olaniyi, I contributed to a geospatial analysis examining how management practices influence ecosystem health in historic rice plantations in Georgetown County, South Carolina. Using multi-sourced Sentinel-2A satellite data processed through Google Earth Engine, I calculated vegetation and moisture indices such as NDVI, NDMI, NDWI, and NDSI. I combined these with climatic and topographic variables including precipitation, elevation, and windspeed, then analyzed spatial patterns within multiple buffer zones to evaluate management strategies. While much of my work was analytical, I also participated in field visits, engaged directly with a land manager, and shared our findings at the Baruch Institute of Coastal Ecology and Forest Science's Behind the Gate seminar.

This experience strengthened my skills in Google Earth Engine, QGIS, and ArcGIS Pro, and refined my ability to perform raster calculations, integrate multi-source data, and adapt analytical methods based on feedback. It also reinforced the importance of collaboration and clear communication, whether through



team discussions, fieldwork, or presenting complex findings to diverse audiences.

Beyond technical growth, this internship expanded my perspective on the role of AI, geospatial analytics, and machine learning in addressing pressing environmental challenges. It clarified my career direction and deepened my commitment to developing intelligent, data-driven tools that support human learning, informed decision-making, and sustainability. In the future, I aim to work at the intersection of AI, environmental systems, and education, designing predictive, user-centered solutions that address complex global issues.

Summer
INTERNSHIP

THE POLLINATOR CONNECTION: FIELD RESEARCH FOR CONSERVATION AND COMMUNITY

Ty Massey

Senior, Environmental and Natural Resources

James C. Kennedy Waterfowl & Wetlands Conservation Center

Clemson University Creative Inquiry

Mentor: Crystal Anderson

Hello! My name is Ty Massey, and I'm entering my senior year as an undergraduate student studying Environmental and Natural Resources. I chose this internship after participating in Crystal Anderson's Ducks, Drones, and Decisions Creative Inquiry course. Following that experience, Crystal shared an opportunity to intern with her on a project focused on pollinator abundance and food security, an area I hadn't worked in before but was eager to explore.

Knowing Crystal's passion and commitment, I saw this as a valuable chance to grow both my field knowledge and technical skills. Throughout the internship, I had the privilege of working alongside an outstanding team, including Crystal Anderson, Wildlife Biologist Keegan Foster, and fellow intern Drew Carroll. My primary role involved conducting pollinator surveys at Hampton Plantation, learning how to dry and pin specimens, helping to preserve a curated collection, and assisting with the development of a public knowledge

and perception survey on pollinators. I gained hands-on experience using nets, vane traps, a weather kestrel, and various lab tools and pinning materials.

In addition to my pollinator work, I was fortunate to assist with other exciting projects, including bird and frog surveys with Keegan and wetland delineation with Dr. Sarah Waickowski. These experiences gave me a well-rounded view of field-based research and expanded my understanding of what a career in wildlife science can be like.

This internship opened my eyes to the possibilities of pursuing advanced degrees and further research opportunities. It inspired me to continue building my skills as a wildlife technician and to stay open to future paths in graduate education. I'm excited to graduate this December and plan to pursue a wildlife technician position in the Colorado Springs area as I continue to grow in the field of environmental resources and wildlife conservation.

Research ABSTRACTS

Research
ABSTRACT

QUANTIFYING HABITAT USE BY SECRETIVE MARSH BIRDS IN ANTEBELLUM RICE FIELDS USING DRONES AND AUTONOMOUS RECORDING UNITS IN COASTAL SOUTH CAROLINA

Akshit R. Suthar
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Secretive marsh birds, including rails, bitterns, and gallinules, inhabit dense vegetation in wetland habitats, posing significant challenges for traditional survey methods. Antebellum rice field impoundments in coastal South Carolina, historically managed for rice cultivation, have become essential habitats for these elusive species. Effective monitoring of these marsh birds is vital for conservation, given their specialized habitat requirements and declining populations. Our research objectives are (1) to quantify habitat use by secretive marsh birds within antebellum rice fields and (2) to develop a cost-effective Drone-deployable Autonomous Recording Units (ARUs) platform to monitor marsh birds in unapproachable areas.

We employed Passive Acoustic Monitoring (PAM) using Audiomoth ARUs (Fig. 1) to record vocalizations of key marsh bird species such as king rail (*Rallus elegans*), clapper

Figure 1: *An AudioMoth autonomous recording device we are using to capture the calls of elusive marsh birds in antebellum rice field impoundments.*

Figure 2: *A Virginia Rail spotted in an antebellum rice field, captured during a drone-based survey.*

rail (*Rallus crepitans*), Virginia rail (*Rallus limicola*) (Fig. 2), sora (*Porzana carolina*), black rail (*Laterallus jamaicensis*), American bittern (*Botaurus lentiginosus*), and least bittern (*Botaurus exilis*) (Fig. 3). We scheduled recordings for one minute every three minutes from 5:45 PM to 9 AM over three consecutive days during peak vocal activity periods (March–June). To enhance survey coverage and minimize human disturbance, we developed a low-cost floating platform (Fig. 4) for ARU deployment and retrieval using drones (Fig. 5). This approach allowed access to remote and otherwise inaccessible locations within large impoundments.

During the recent field season, we successfully deployed ARUs and surveyed a total of 55 rice field impoundments. Overall, 250 ARUs were deployed, resulting in the collection of approximately 229,000 audio files and around 4,000 hours of acoustic recordings. The deployment and retrieval using drones proved highly effective and efficient, significantly reducing time, labor, and disturbance compared to traditional methods.

Preliminary analysis of acoustic data using the BirdNet AI model demonstrated reliable species identification (Fig. 6), enabling robust quantification of marsh bird presence and vocal activity across different habitat types. Our

innovative drone-based ARU deployment methodology significantly improves monitoring capabilities for secretive marsh birds. The increased coverage and precision of our acoustic data collection provide invaluable insights into habitat use and preferences within antebellum rice field ecosystems. These advancements facilitate effective conservation strategies and habitat management for these elusive marsh bird species, underscoring the value of integrating technology-driven approaches in wildlife research.

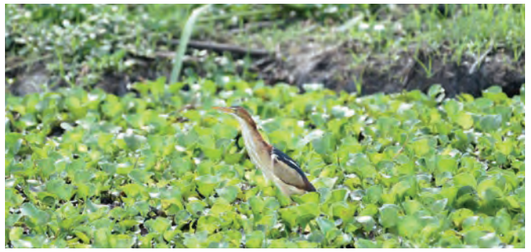


Figure 3: *A well-camouflaged Least Bittern blending seamlessly into the dense vegetation of an antebellum rice field impoundment.*

Acknowledgments

I gratefully acknowledge the James C. Kennedy Waterfowl & Wetlands Center and Nemours Wildlife Foundation for their graduate research fellowship and logistical support. I thank the Andy Quattlebaum and Blackwell Family Foundation, Ducks Unlimited, and SC Sea Grant for funding support. The Society of Wetland Scientists, Slocum Lunz Foundation, and TWS Wetlands Working Group for student research grants. National Bobwhite and Grassland Initiative, SC Cooperative Fish and Wildlife Research Unit and Folk Land Management, Inc for technical support and SCDNR staff, managers, and landowners for their permission to survey the properties and invaluable assistance during data collections. I thank Bhumika, Dhyana, and Heena Suthar for assistance with Drone-deployable ARU platform prototype development and testing, and Kai Schmitt and Randeep Singh for field support.

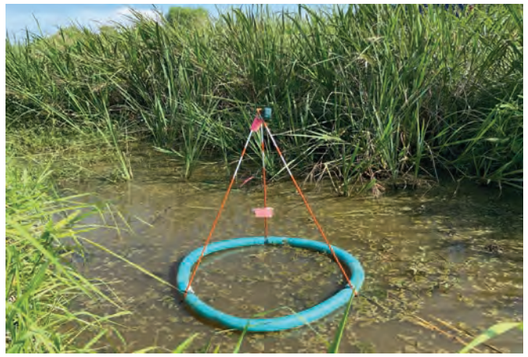


Figure 4: *A lightweight, low-cost floating platform designed to hold an AudioMoth ARU for remote acoustic monitoring.*

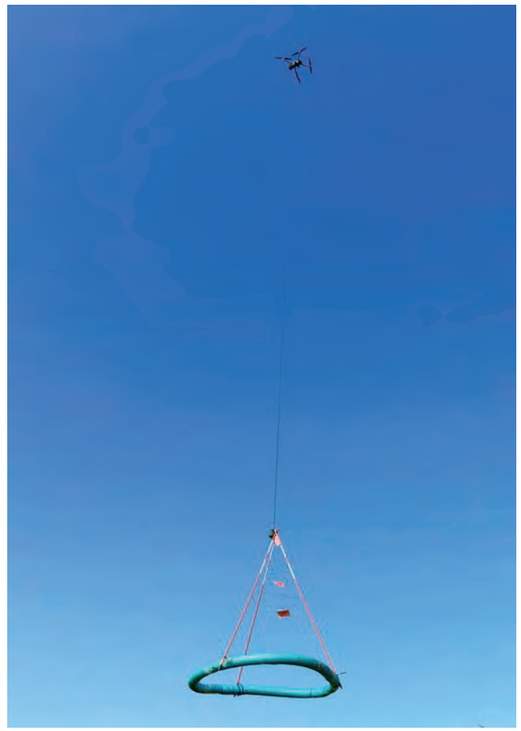


Figure 5: *Using a drone to deploy and retrieve the floating ARU platform in otherwise inaccessible wetland areas.*

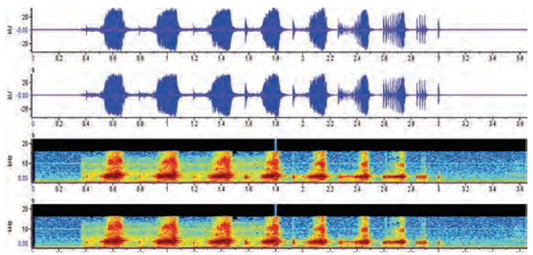


Figure 6: *A spectrogram visualizing a Virginia Rail's call, identified with the BirdNET artificial intelligence model.*

Research

ABSTRACT

eDNA TECHNIQUES FOR THE DETECTION OF HIGHLY PATHOGENIC AVIAN INFLUENZA IN WETLAND ENVIRONMENTS

Andrew Patrick Hopkins
Post-Doctoral Fellow, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Surveying and sampling waterfowl for highly pathogenic avian influenza requires large amounts of time and effort in addition to causing disturbances that lead to increases in stress in target species. Furthermore, many avian species are cryptic in nature, and normal surveillance techniques are not adequate for confirming their presence or absence. However, recent advances in genetics and affordability have made previously inaccessible genetic surveillance methods more affordable and feasible.

Among the risks of habitat loss and land use change currently threatening waterfowl, they also face threats from the spread and proliferation of highly pathogenic avian influenza or HPAI. Current surveillance strategies primarily focus on live-captured species, fecal testing, or postmortem collection following mortality events. While these methods can be useful for detecting viruses, they require direct handling, which is sometimes difficult to achieve. Additionally, act to confirm the presence of the virus after it is already present in the environment. With the use of environmental DNA or eDNA, it may be possible to shift this screening and surveillance from a reactive approach to a predictive and proactive approach. Using this methodology, we can test the environment for the presence of HPAI before outbreaks occur, thus allowing mitigation and focus to be directed towards potential hotspots.

The goal of this research is to test the efficacy and reliability of using eDNA methodologies to measure and detect HPAI, as well as cryptic species. Through the nature of this sampling, we are able to highlight and focus on areas and ponds that these normal survey methods are not able to focus on. As mentioned, one of the primary

methodologies for current surveillance is to test carcasses from hunter-harvested kills. While this is an advantageous technique, it places a bias on game species and misses the wetland infrastructure and ponds that have a closer overlap with human activities.

Our objectives and goals with this research are to develop a system that could be implemented by management agencies to more effectively screen HPAI in wetlands, ponds, and other areas that are key for waterfowl activity or human use. Once the methods and techniques for efficient extraction and verification have been established, we aim to combine environmental data and species presence/absence to better identify areas that are most at risk of serving as carriers in this region or identify environments that are conducive for the proliferation of spread.

In addition to the disease surveillance aspect of this research, eDNA is also capable of improving the surveillance of cryptic species in the environment. Some waterfowl and wetland species are more secretive, and eDNA represents an adaptable system to screen for the presence of these species in a way that is non-invasive. This will allow for the identification of habitats that might often be overlooked, thus conserving wetland habitat and quality for species.

Methodology

Field Collection : We used a peristaltic pump fitted with 0.2-micron filters to sample wetlands and ponds for eDNA. In our current exploratory study, we selected five different ponds and surveyed four points at each pond. At each point, we filtered approximately 15 liters of water through the filter or roughly ~20 minutes of filtering. Following filtration, we stored each eDNA filter on dry ice and then at -80 °C until the samples were ready for processing.

Viral Processing: Samples were transported to the Clemson University Genomics and Bioinformatics Facility for RNA extractions. Viral RNA was extracted from wetland water samples using a Zymo Quick DNA/RNA Viral MagBead extraction kit (Zymo, Irvine, CA) according to manufacturer recommendations including optional treatment steps. Sample quality and quantity were assessed with a Qubit 4.0 fluorometer (Thermo Fisher) and assessed with an Agilent TapeStation 4200 (Agilent, Santa Clara, CA). Samples were stored at -80 °C until they were shipped to the Clemson University Veterinary Diagnostic Center for Avian Influenza testing via qPCR.

Results

In total, from 24 samples, we were able to detect readable levels of viral RNA in 11 samples. Upon sending these 11 samples to the diagnostic laboratory, we were able to confirm the presence of avian influenza in one sample. However, while we confirmed the presence of avian, the concentration was not at the levels that would allow for additional screening to identify the subtype further through genomic screening.

Discussion

This work has shown that our initial methodology is successful in extracting and identifying avian influenza strains from water samples in wetlands. This has implications for pathogen surveillance and future detection of the disease. As stated, most current screening focuses on commercial or game species and does not investigate the environment itself, which can be a suitable reservoir.

While our current methodology has proved successful, we are looking to expand our screening. First, we are implementing new filters that will allow us to access the RNA more easily. It is possible that we had more positives than we found, but the process of extraction was impeded due to filter quality and design. Second, we are aiming to expand our screening to stormwater ponds, which can act as temporary stopovers for numerous avian species that are shown to be reliable carriers of the pathogen (geese, swans, etc.). Finally, we are aiming to combine this work with ongoing drone and environmental survey work to create predictive maps for the spread and risk of avian influenza.

Acknowledgments

I thank Dr. James Anderson for his support of this project as well as Maslyn Greene and the staff of the Clemson University Genomics and Bioinformatics facility. Without their assistance, this work would not have been possible.

Research

ABSTRACT

ECOLOGICAL ASSESSMENT AND DECOMPOSITION DYNAMICS AT A PRE-RESTORATION SALTMARSH SITE ON LITTLE EDISTO ISLAND, SC

Rene Brown
Master's Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Introduction

The purpose of this research is to characterize baseline ecological conditions and evaluate key ecosystem processes prior to the hydrologic reconnection and restoration of the S-161 Restoration Site, a 21-hectare former shrimp aquaculture facility on Little Edisto Island, South Carolina, to functional saltmarsh. The study integrates seasonal monitoring of water quality, vegetation, and fish communities, along with a year-long decomposition experiment examining dominant saltmarsh plant species. Together, these efforts aim to provide science-based guidance for future restoration design and management.

Research Objectives

- Assess seasonal variations in water quality (e.g., salinity, pH, DO, temperature, conductivity).
- Examine the effects of tidal fluctuation on fish distribution, abundance, and diversity.
- Monitor seasonal changes in vegetation species richness and percent cover.
- Compare decomposition rates of Black Needlerush (Juncus roemerianus) and Smooth Cordgrass (Sporobolus alterniflorus) across hydrologically distinct impoundments.
- Identify environmental drivers influencing decomposition rates.

Methodology

This research employed a field-based, quantitative approach conducted across six brackish impoundments within the S-161 site. Water quality was measured seasonally using a multiparameter probe to assess salinity, pH, dissolved oxygen, temperature, and conductivity. Additional laboratory analyses followed EPA protocols for nitrate and phosphate concentrations. Fish communities were sampled quarterly using seines, cast nets, minnow traps, and crab traps. Captured individuals were identified to species, measured, and weighed to assess relative abundance and diversity across space and time.

Vegetation surveys included percent cover estimates, species identification, and geospatial mapping. A decomposition experiment was implemented using 252 mesh litterbags containing oven-dried leaves of either J. roemerianus or S. alterniflorus. Litterbags were

deployed across all six impoundments and retrieved at scheduled intervals between 14 and 365 days to measure mass loss and analyze changes in tissue composition (protein, hemicellulose, cellulose). Monthly environmental monitoring was conducted at each decomposition site to associate decay rates with local abiotic conditions.

Analytical techniques included one-way and repeated-measures ANOVA, Shannon-Wiener Diversity Index calculations, and linear mixed-effects models using R. Decomposition rates were modeled using exponential decay functions, and regression analysis was used to identify the influence of environmental variables on decay constants.

Expected Findings

It is anticipated that water quality parameters will exhibit strong seasonal variation, with elevated salinity and temperature during summer and reduced dissolved oxygen in warmer months. Fish distribution and diversity are expected to correlate with both tidal influence and water quality conditions. Vegetation composition is likely to shift seasonally, with potential dominance changes among species across impoundments. In terms of decomposition, S. alterniflorus is expected to exhibit faster decay rates than J. roemerianus due to its thinner leaf structure. Decomposition is predicted to slow in areas with frequent inundation and lower oxygen availability.

Discussion

The results of this study will establish an ecological baseline essential for evaluating future restoration success. By linking biotic patterns to physical and chemical gradients, the findings will guide site-specific restoration practices, including vegetation selection and hydrologic modifications. Understanding how environmental drivers influence key processes like decomposition will support the development of more resilient and functional saltmarsh ecosystems on legacy aquaculture sites across the southeastern United States.

Acknowledgements

I want to thank Dr. James T. Anderson for providing me with this opportunity and for his ongoing support and guidance. I am also grateful to Christopher Pettengill and Keegan Foster for their invaluable assistance with fieldwork, and to Dr. Andrew Hopkins for his thoughtful feedback on my research proposal.

Research

ABSTRACT

A DECADAL CHANGE IN SHOREBIRD POPULATIONS IN RESPONSE TO TEMPERATURE, WIND, AND PRECIPITATION AT HILTON HEAD ISLAND, SOUTH CAROLINA, USA

Akshit R. Suthar
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Despite increasing conservation efforts for shorebirds, there are widespread declines in many shorebird species in North America. Climate change is causing significant shorebird range shifts and population declines. This study investigates the relationship between meteorological variability and shorebird population dynamics over ten years (2014–2023) at Fish Haul Beach, Hilton Head Island, South Carolina, USA (Fig.1). Shorebirds, reliant on specific habitats for breeding and foraging, are increasingly vulnerable to climate-driven changes, including shifts in temperature, precipitation, and wind speed. Using Generalized Additive Models with Poisson distribution, we analyzed species-specific count data for 12 shorebird species in relation to annual meteorological variables (Fig 2). Additionally, the Mann–Kendall test and Sen's slope were employed to assess decadal trends in population counts (Fig.3). The results reveal significant declines in Black-bellied Plover (*luvialis squatarola*), Marbled Godwit (*Limosa fedoa*) (Fig.4), and Willet (*Tringa semipalmata*) (Fig.5). In contrast, Semipalmated Plover (*Charadrius semipalmatus*) and Piping Plover (*Charadrius melodus*) (Fig.6) showed increasing trends, indicating potential habitat benefits or conservation success. Temperature emerged as a key driver affecting the abundance of several species, while precipitation and wind speed also played crucial roles in shaping population dynamics.

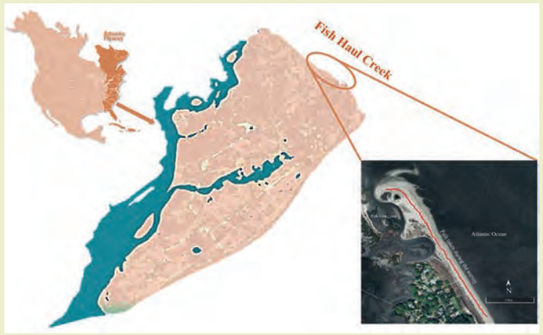


Figure 1: Hilton Head Island, South Carolina, serves as a critical stopover site along the Atlantic Flyway, providing essential beach and mudflat habitats for migrating shorebirds.

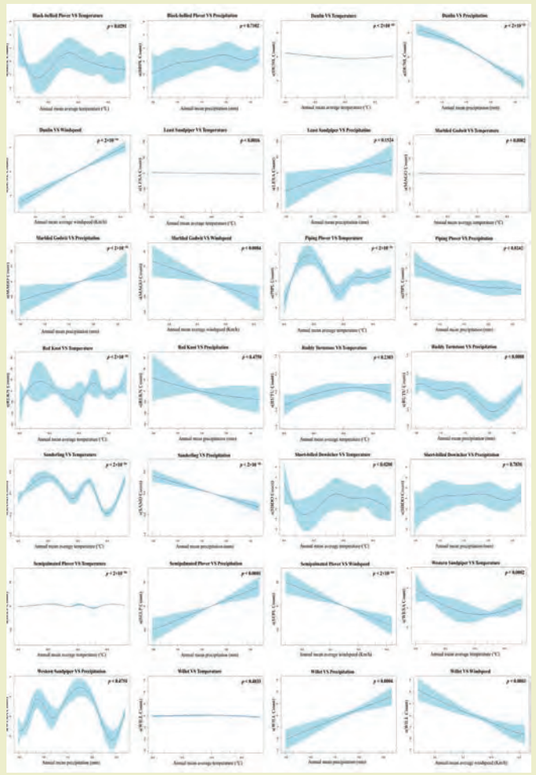


Figure 2: Visualization of the best-fitted GAMs with a log link function, showing the effects of meteorological covariates on shorebird abundance. The solid blue line represents the smooth term for each covariate, and the shaded light blue area indicates the 95% confidence interval.

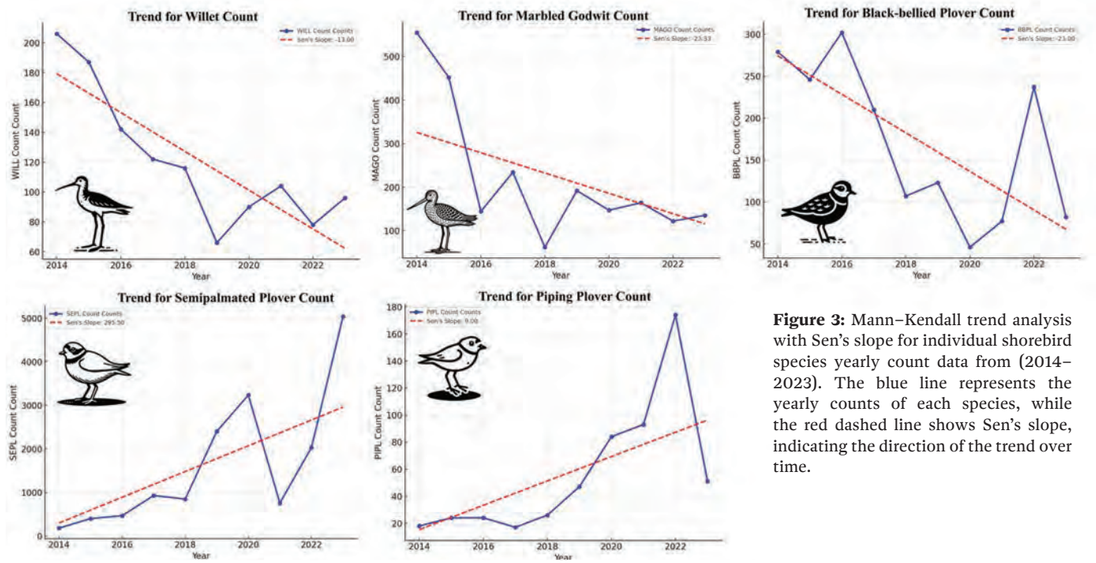


Figure 3: Mann–Kendall trend analysis with Sen's slope for individual shorebird species yearly count data from (2014–2023). The blue line represents the yearly counts of each species, while the red dashed line shows Sen's slope, indicating the direction of the trend over time.

These results provide a clearer understanding of how climate variability affects individual species and also highlight the broader vulnerability of migratory shorebirds that depend on stopover habitats during their annual journeys. Our findings underscore the sensitivity of shorebird populations to weather fluctuations, emphasizing the need for integrating meteorological variability into management strategies to ensure shorebird conservation. By linking long-term monitoring with climate analysis, this study offers valuable guidance for conservation planning and reinforces the importance of maintaining resilient coastal ecosystems in South Carolina and beyond.

Acknowledgements

Appreciation is extended to Abby Sterling (Manomet.org) and the following individuals who volunteered their time to count shorebirds: Fran Baer, Denny Baer, John Bloomfield, Carol Clemens, Jack Colcolough, Doreen Cubie, Wendy Dickes, Grant Greider, Jane Hester, Pauline Jones, and Aaron Palmieri. We especially acknowledge the contributions of Fran Baer, who maintained the data for most of the project period. Appreciation is also extended to Carol Clemens for tirelessly organizing the volunteers, selecting the survey timing, and communicating with the Port Royal neighborhood property managers.

Figure 4: Marbled Godwit (*Limosa fedoa*), one of the species showing significant population declines in our long-term monitoring study at Fish Haul Beach, Hilton Head Island, South Carolina. Photo credit: Dr. Alan Biggs.

Figure 5: A Willet (*Tringa semipalmaa*) displaying while foraging in the shallows at Fish Haul Beach, Hilton Head Island, South Carolina. Long-term monitoring has documented notable declines in this species, reflecting broader challenges faced by coastal shorebirds. Photo credit: Dr. Alan Biggs.

Figure 6: Piping Plover (*Charadrius melodus*) on the sandflats at Fish Haul Beach, Hilton Head Island, South Carolina. Unlike several declining shorebird species, this federally protected bird showed an increasing trend in our long-term monitoring, reflecting the potential benefits of targeted conservation. Photo credit: Dr. Alan Biggs.

Research

ABSTRACT

FORECASTING CHANGES IN CAROLINA BAY BIOTIC COMMUNITIES UNDER MULTIPLE FUTURE LAND USE SCENARIOS

Scott Binger
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Introduction

The coastal plain of South Carolina is a region of rapid population growth and development, and there is consistent pressure on natural habitats due to this growth. Carolina Bays, due to their nature as isolated wetlands, lack federal protection and as such have been historically subject to anthropogenic disturbances such as drainage. When intact, these unique ecosystems provide forage and nesting opportunities for Wood Ducks (*Aix sponsa*) and other wetland-using birds. Understanding the potential impact of further development on biotic communities in these wetlands will be essential to planning and prioritization of conservation efforts. Our objective is to use information about the relationships between current and past land use and biotic communities to predict how Carolina Bay biota in South Carolina may be affected by land use changes over the next 75 years.

Methodology

Both qualitative and quantitative biotic and abiotic data will be used to derive relationships between current and past land use, including National Land Cover Database data, and biodiversity data from in-depth biotic sampling data at 70 Carolina Bays in the coastal plain of South Carolina. We will then use USGS FORE-SCE land cover projections from 2025-2100 under four distinct scenarios of population growth and resource use to predict how diversity and species composition of biotic communities may respond to each scenario, using a linear mixed model approach.

Results

We anticipate that under all projected land use change scenarios, Carolina Bays within areas of high human development will exhibit lower species richness and functional diversity. Scenarios with the smallest increase in human development will have a smaller extent and a lower intensity of these reductions throughout the study area, and scenarios with widespread human development will show large-scale biodiversity reductions within and across taxonomic groups, including lower abundance of Wood Ducks and other wetland-using birds.

Discussion

The predictions that our analysis generates will help to identify areas of special focus for conservation and restoration efforts, highlighting the potential long-term effects of development on state-wide biodiversity and waterfowl distribution.

Acknowledgements

Crystal Anderson (Wildlife Biologist) - Study Design, Funding Acquisition, and Study Execution

Keegan Foster (Wildlife Biologist) - Field Investigation and Study Execution

Alli Healy & Anna Johnson (Interns) - Field and Lab Investigation

This project has received funding from the Environmental Protection Agency.

This project has received support from SCDNR, SCFC, SCNPS, USFS, Francis Marion University, and other private partners.

Research

ABSTRACT

CULTIVATING RESILIENCE: USING COMMUNITY GARDENS, WETLAND POLLINATORS, AND SPATIAL MODELING TO PROMOTE FOOD SECURITY AND PREDICT CLIMATE-DRIVEN POLLINATOR RANGE SHIFTS.

Crystal M. Anderson
Doctoral Student, Clemson University
James C. Kennedy Waterfowl & Wetlands Conservation Center

Figure 1

Background

Amid rising food insecurity, pollinator decline, and accelerating climate change, our research explores the socio-ecological factors driving community resilience and biodiversity conservation. Pollinators, particularly Lepidoptera and Apidae, are essential to ecosystems and agriculture, supporting the reproduction of 75% of flowering plants and 35% of global crops. Despite their importance, pollinator populations continue to decline due to habitat loss, environmental stressors, and limited public awareness.

This research is also important for waterfowl conservation, as pollinator-supported vegetation forms the foundation of wetland food webs that sustain migratory and resident birds. In coastal South Carolina, pollinator-dependent plants such as smartweeds (*Polygonum spp.*), wild millets (*Echinochloa spp.*), and swamp sunflowers (*Helianthus angustifolius*) provide seeds and cover used by species such as blue-winged teal (*Anas discors*), northern pintail (*Anas acuta*), and mallard (*Anas platyrhynchos*). Diverse floral resources also support invertebrates that serve as critical prey for brooding and staging waterfowl such as gadwall (*Mareca strepera*) and green-winged teal (*Anas crecca*). By stabilizing wetland vegetation and maintaining food availability, pollinators indirectly enhance habitat quality for waterfowl.

Rural communities in the Southeastern United States face significant barriers to food access and environmental knowledge. Community gardens offer a promising solution by enhancing food availability, fostering local ecological understanding, and providing vital habitat for pollinators.

Figure 2

Figure 3

Objectives

1. Community Food Security and Environmental Literacy
    - Assess food access and plant knowledge in a rural community (Figure 1)
    - Establish a community garden with pollinator education (Figure 2)
    - Measure changes in food access, awareness, and conservation behavior (Figure 3)
2. Pollinator Diversity Across Wetland Ecotones
    - Survey Lepidoptera and Apidae diversity across habitats (Figure 4:5)
    - Examine environmental drivers of species presence
    - Analyze spatial and temporal biodiversity trends to inform habitat conservation and link floral availability to waterfowl forage plants
3. Modeling Climate-Driven Pollinator Range Shifts
    - Use GIS and species distribution models to map how environmental gradients affect pollinators and host plant distributions
    - Project future habitat suitability under various Intergovernmental Panel on Climate Change scenarios
    - Identify areas of future conservation importance and vulnerability for pollinators and the waterfowl species that depend on their services

Methods

We conducted community surveys in McClellanville, South Carolina to assess food access, gardening barriers, pollinator knowledge, and local engagement. Responses, collected at a public event and analyzed using Qualtrics, guided the development of a community garden and educational signage.

To examine pollinator communities, we established year-round sampling plots in planted pine, brackish impoundments, and open prairie habitats. Surveys used line transects, pan and vane traps, and monarch tagging, alongside environmental data collection such as temperature, salinity, and floral cover. Data are being analyzed using statistical and ecological modeling approaches, including GLMs, diversity indices, NMDS, and PERMANOVA.

We are also developing GIS-based species distribution models to link pollinator and host plant occurrences with environmental gradients. These models incorporate field data, habitat characteristics, and climate projections to forecast future range shifts and identify areas of conservation concern. Outcomes will directly inform wetland managers who seek to sustain waterfowl forage through pollinator-friendly practices.

Results and Anticipated Outcomes

Initial findings show that cost, limited gardening knowledge, and weak community support are key barriers to participation. Despite these barriers, there is strong interest in gardening, especially in growing familiar and locally important plants. Educational outreach is expected to improve food access and ecological awareness, though long-term trust and engagement may take time to build.

Figure 4

Pollinator surveys are anticipated to show higher diversity in open prairie habitats and lower richness in brackish areas, with floral density, salinity, and temperature as key drivers. These patterns will help identify which wetland plants contribute most directly to the food resources of dabbling ducks such as blue-winged teal, northern pintail, and mallard. Seasonal shifts in pollinator activity are expected to align with critical staging and wintering periods for waterfowl, highlighting shared ecological benefits.

Our spatial models will help predict how climate change may alter plant-pollinator dynamics. Loss of key pollinators could diminish seed production in wetland forage plants, reducing habitat quality for waterfowl. In contrast, conservation of pollinator habitats may sustain forage availability and enhance resilience of migratory species.

Figure 5

Significance

This integrated approach addresses pressing concerns in pollinator conservation, food security, and climate adaptation while also advancing waterfowl conservation. By merging community engagement, ecological research, and spatial modeling, we propose a framework for sustaining biodiversity and human well-being. Our findings will inform local garden initiatives, pollinator habitat restoration, and adaptive land management strategies that support both people and wildlife.

The inclusion of waterfowl context highlights how pollinator conservation maintains wetland vegetation, seed production, and invertebrate prey essential for species such as mallard, blue-winged teal, northern pintail, gadwall, and green-winged teal. Protecting pollinators therefore contributes directly to the carrying capacity of South Carolina's coastal wetlands for migratory waterfowl.

This research demonstrates how pollinators connect community well-being with waterfowl conservation, linking human resilience with ecological integrity.

Acknowledgements

We gratefully acknowledge James C. Kennedy for his steadfast support of waterfowl and wetland research. We thank the NRCS USDA for providing the funding that made this project possible, and Clemson Extension for their pro-bono assistance in the community garden, which helped ensure residents had improved access to gardening resources. Special thanks go to Sharlene Johnson for her dedication to selecting native and purposeful pollinator plants that enriched both the educational and community garden spaces. We also recognize the Charleston County Native Plant Society for their generous financial contribution to meet project needs. Finally, we extend our sincere appreciation to the community surrounding Hampton Plantation, whose donation of garden space and ongoing collaboration were essential to the success of this initiative.

Figure 6

Research
ABSTRACT

DEVELOPING A DECISION SUPPORT TOOL TO PROTECT AND RESTORE SOUTH CAROLINA'S HISTORIC RICE FIELD WETLANDS

Oluwatobi Olaniyi
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Background

The rice fields of antebellum South Carolina once covered nine coastal counties with more than 95,000 hectares, operating as a thriving plantation economy. Today, these historic rice fields serve as vital wetlands that support wintering populations of wood ducks (*Aix sponsa*), mottled ducks (*Anas fulvigula*), and American black ducks (*Anas rubripes*). However, these engineered landscapes face growing threats from rising sea levels, saltwater intrusion, failing infrastructure, and shifting political and social priorities.

Research Objective

This project aims to develop a comprehensive Decision Support Tool (DST) for managing and restoring endangered cultural and ecological assets within these rice field systems. The DST will integrate multiple criteria to assess ecological, hydrological, climatic, and socio-economic factors, ultimately guiding site-specific management and restoration strategies.

Study Design and Methods

The study will evaluate 27 representative rice field sites, tidal and inland, public and private, classified as functional or non-functional. Preliminary observations suggest that inland rice fields maintain greater hydrological stability and higher conservation potential than tidal fields, which are more vulnerable to tidal forces and management failures.

Data collection will include:

- LiDAR-derived digital elevation models at high resolution
- Long-term climate records
- Land cover classifications
- Species occurrence data

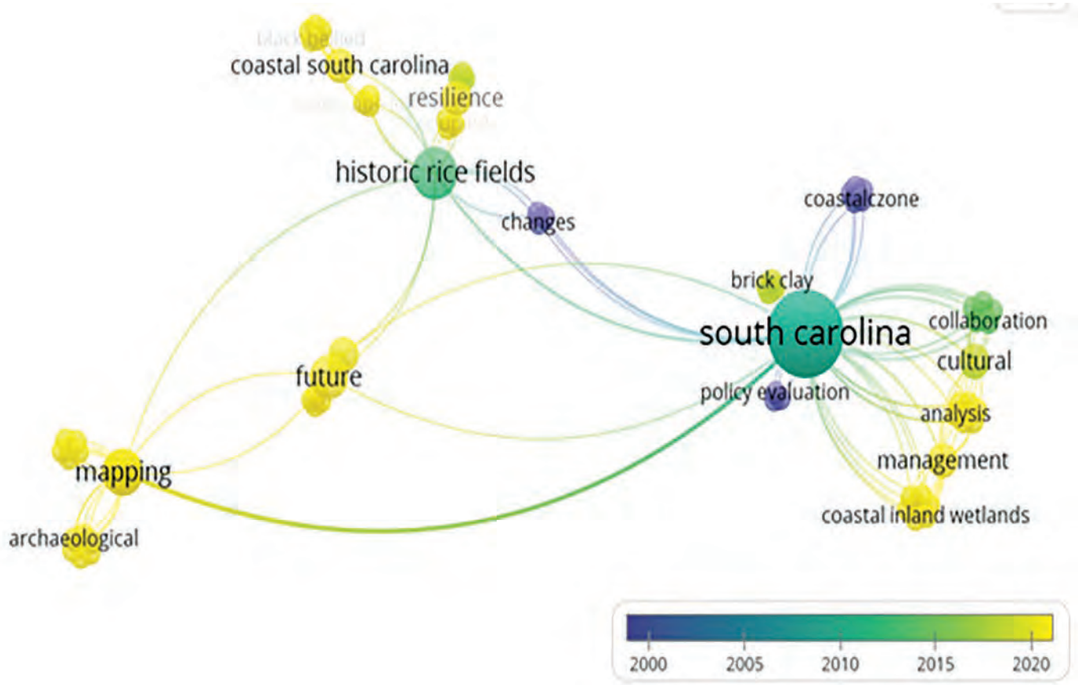
Socio-cultural information will be gathered through stakeholder meetings with plantation managers, residents, and members of the Gullah Geechee community. Rapid ecological field assessments and bibliometric analysis of restoration literature will be used to identify best practices and knowledge gaps.

Analytical Framework

The core of the DST will be the Analytical Hierarchical Process (AHP), applying expert-validated ecological and social variables to generate habitat suitability models and climate adaptation pathways. Additionally, the InVEST Habitat Risk Assessment model will help develop a risk-benefit matrix, predicting environmental and economic trade-offs among different management approaches.

Preliminary Findings and Significance

Initial assessments reveal that 62% of tidal rice fields show severe infrastructure deterioration, while 74% of inland sites retain functional hydrological systems. The DST will serve as a model for climate-vulnerable coastal wetland systems worldwide by enhancing waterfowl habitat resilience and guiding targeted interventions. This work will protect the ecological services and historical value of South Carolina's rice landscapes for future generations.



Acknowledgements

I am deeply thankful to my advisory committee members, Prof. James T. Anderson (Chair), Dr. Troy Farmer (Co-Chair), Prof. David White, and Dr. Travis Folk, for their continuous guidance, detailed feedback, and academic support during this research. I appreciate the financial and institutional support of the James C. Kennedy Waterfowl Wetland Conservation Center and Clemson University for this research. This project also benefited from generous data access and resources from collaborators, including USGS, NASA Earthdata, EPA EnviroAtlas, USDA, South Carolina Sea Grant Consortium, SCDNR, and the U.S. Forest Service. I am grateful to the Kennedy Center's research archive for its contributions and to all plantation managers, stakeholders, and community partners across the historic rice fields of South Carolina for their insights and support. Their collaboration made the socio-ecological and restoration components of this study possible.

Research

ABSTRACT

MAPPING CLIMATE VULNERABILITY RISK: PFAS AND MICROPLASTICS IN THE SOUTH CAROLINA COASTAL PLAIN

Dorothy Aldridge
Master's Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Introduction

Coastal wetlands serve as transitional systems that filter contaminated stormwater runoff and industrial discharges, often sequestering and transforming harmful pollutants through microbial processes and plant uptake. However, contaminants of emerging concern that resist degradation, such as per- and polyfluoroalkyl substances (PFAS) and microplastics, persist and accumulate in wetland sediments, threatening wildlife and fisheries. Despite heightened climate influence on these low-elevation systems, research is limited to the integrated effect of climate and landscape changes on the distribution of these contaminants. The objective of this study is to synthesize meteorological and environmental drivers of PFAS and microplastic presence in South Carolina's coastal plain, together with indicators of resilience, to map watershed vulnerability. The resulting risk assessment will reveal which coastal watersheds are most susceptible to contaminant exposure, and how that vulnerability varies under multiple greenhouse gas emission scenarios.

Methodology

We will compile publicly available PFAS and microplastic data from the South Carolina Department of Environmental Services' (SCDES) Ambient Surface Water PFAS Monitoring project, open access data repositories, and collected surface water samples. To illustrate current contamination levels, we will generate predictive hotspot maps for each contaminant using the GIS Pro Universal Kriging toolkit to produce rasterized surface water concentration values within the South Carolina coastal plain and nearshore marine waters. We will calculate vulnerability scores for each Hydrologic Unit Code (HUC10) watershed (~200 mi²) using the Intergovernmental Panel on Climate Change (IPCC) framework, which defines vulnerability as a function of exposure, sensitivity, and adaptive capacity (IPCC 2001; IPCC 2007). The project team will select quantitative exposure indicators

within categories of hydrology, precipitation, and sea level rise. To model meteorological variables under two greenhouse gas emission scenarios, Representative Concentration Pathways (RCP) 4.5 and 8.5, we will use the Hydrologic and Water Quality System (HAWQSv2.0) online tool, which statistically downscales multiple global climate models. The analysis aggregates projected changes from the historical baseline (1986–2005) to the midcentury future (2040–2059) into composite exposure scores. These values are compared to quantitative measures of a watershed's capacity to adapt to contaminant exposure such as landcover change, wetland type, stormwater pond density, and percent impervious surfaces. The project team will weigh these indicators of resilience and exposure and synthesize them into a vulnerability calculation.

Anticipated Results

We expect indicators of increased anthropogenic influence, measured by population density, land use alteration, and percent impervious surfaces, to have a positive relationship with vulnerability scores. Environmental characteristics such as high soil organic matter and low energy hydrodynamics are also expected to increase PFAS exposure scores. We expect to see greater vulnerability scores under the higher RCP 8.5 emissions scenario compared to RCP 4.5, due to higher sea levels inundating novel contaminant sources and increased deposition of pollutant runoff into low-lying wetlands. However, we predict the difference between emission scenarios will be lower in watersheds implementing climate mitigation infrastructure, such as stormwater ponds, living shorelines, and seawalls.

Discussion

By integrating complex climate and contaminant variables, this approach provides land managers and decision makers with actionable information that is otherwise difficult to synthesize. Evaluating vulnerability under multiple emission scenarios captures the dynamic nature of coastal systems and supports adaptive management strategies that incorporate future climatic conditions. Comparing species' life histories with the location and drivers of contaminant hotspots in South Carolina's coastal plain can help to distinguish species most at risk of exposure such as long-lived waterfowl reliant on aquatic food sources.

Acknowledgments

I acknowledge the support of Miriam Boucher, Dr. Stefanie Whitmire, Dr. Thomas Rainwater, and Dr. Jim Anderson, as well as South Carolina Sea Grant, for providing funding for this research (NOAA award No. NA24OARX417C0591 – CFDA#11.417).

References

Intergovernmental Panel on Climate Change. (2001). Climate change 2001: Impacts, adaptation, and vulnerability (J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken, & K. S. White, Eds.). Cambridge University Press.

Intergovernmental Panel on Climate Change. (2007). Climate change 2007: Impacts, adaptation and vulnerability (M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, & C. E. Hanson, Eds.). Cambridge University Press.

Research

ABSTRACT

EVALUATING WATERFOWL DETECTION PROBABILITY USING THERMAL AND COLOR DRONE IMAGERY FROM ANTEBELLUM RICE FIELDS OF COASTAL SOUTH CAROLINA, USA

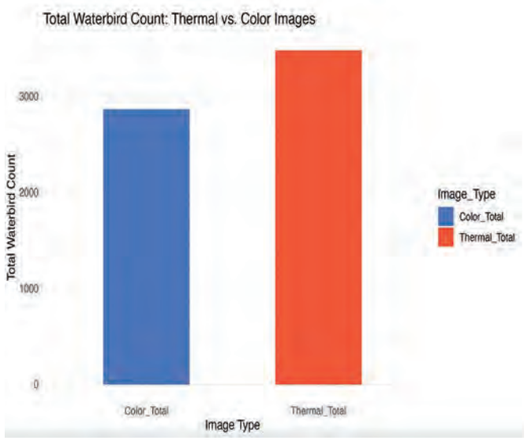
Akshit R. Suthar
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Accurate detection of waterfowl is essential for monitoring populations and informing conservation management. Drone technology offers an efficient and non-invasive method for waterfowl surveys, but the effectiveness of thermal and color imagery for detecting waterfowl remains understudied. This study compares detection probabilities between thermal and color imagery, assesses bird count differences, and evaluates the potential benefits of integrating thermal imagery into aerial waterfowl surveys. Using a DJI Mavic 3T enterprise drone equipped with dual cameras (Fig. 1), we collected 300 images (150 thermal and 150 color) from a managed antebellum rice field impoundment. Six independent observers (Fig. 2) manually counted waterfowl in a randomized set of images using the DotDotGoose object counting tool, with each observer analyzing 25 thermal and 25 color images. Thermal imagery consistently detected higher numbers of waterfowl with 3,478 waterfowl counted compared to 2,865 from color images (Fig. 3). A paired t-test indicated a statistically significant difference in detection ($p < 0.0051$) (Fig. 4), suggesting thermal imagery is more effective in dense vegetation, camouflage background color or low-light conditions where birds are less visible in color images (Fig. 5). However thermal imaging has challenges when birds are clustered together. These findings highlight thermal imagery in drone surveys enhancing detection accuracy and minimizing undercounting. This study provides valuable insights for wildlife managers, aiding in accurate population assessments and technological monitoring strategies.

Figure 1: Akshit Suthar, Ph.D. student, flying a DJI Mavic 3T drone equipped with both thermal and RGB cameras for waterfowl surveys.

Figure 2: Six independent observers counting waterfowl using thermal and color drone images with the DotDotGoose object-counting tool.

Figure 3: Total number of waterfowl detected from color versus thermal drone imagery.



Acknowledgments

I gratefully acknowledge the James C. Kennedy Waterfowl & Wetlands Center and Nemours Wildlife Foundation for their graduate research fellowship and logistical support. I thank the Andy Quattlebaum and Blackwell Family Foundation, Ducks Unlimited, and SC Sea Grant for funding support. I thank Clemson University Creative Inquiry students for assisting me with drone-based image analysis. The Society of Wetland Scientists, Slocum Lunz Foundation, and TWS Wetlands Working Group for student research grants. National Bobwhite and Grassland Initiative, SC Cooperative Fish and Wildlife Research Unit and Folk Land Management, Inc. for technical support and SCDNR staff, managers, and landowners for their permission to survey the properties and invaluable assistance during data collections.

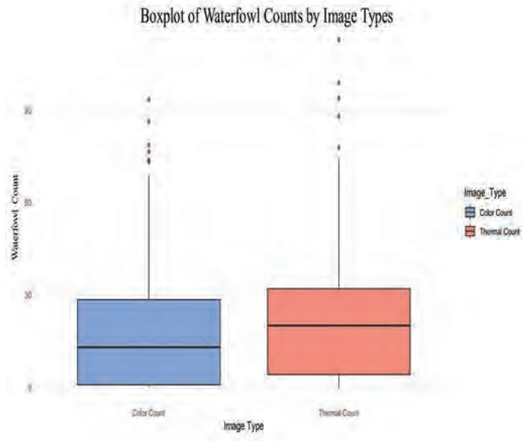
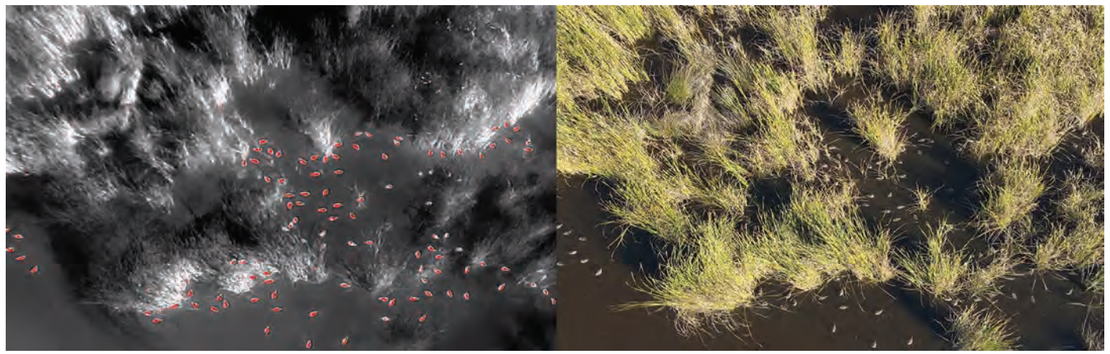


Figure 4: Distribution of waterbird counts recorded from color and thermal drone images.

Figure 5: Side-by-side comparison of the same scene in color and thermal imagery, showing waterfowl detection differences.



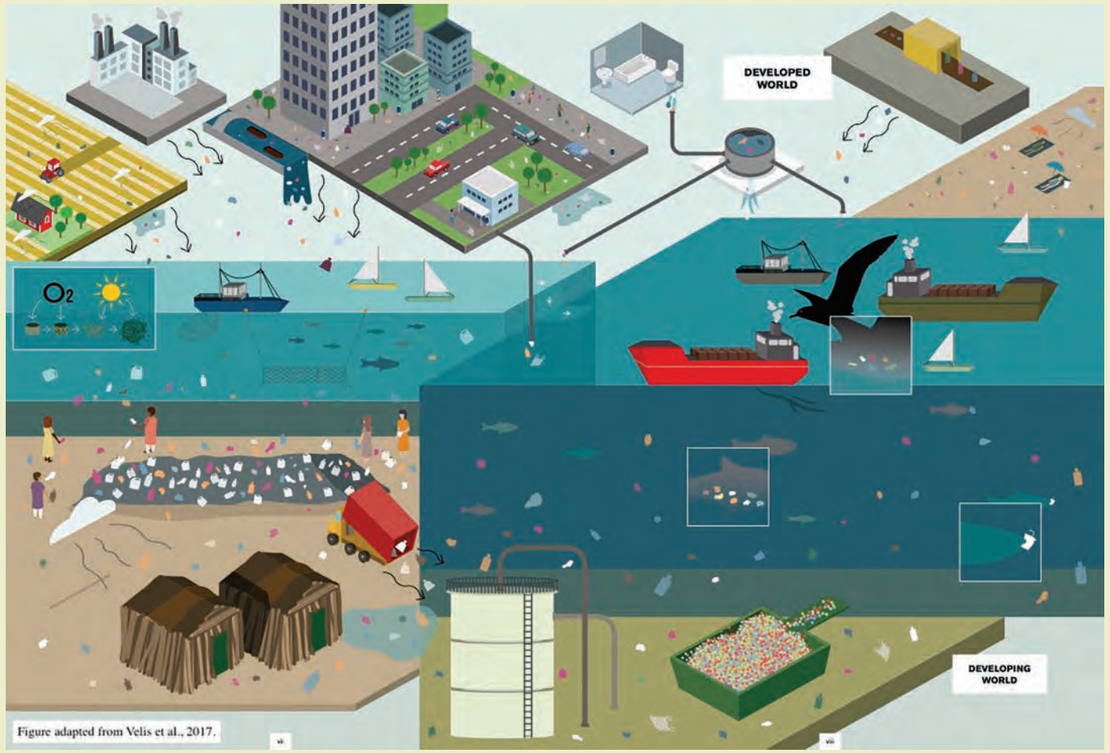
Research

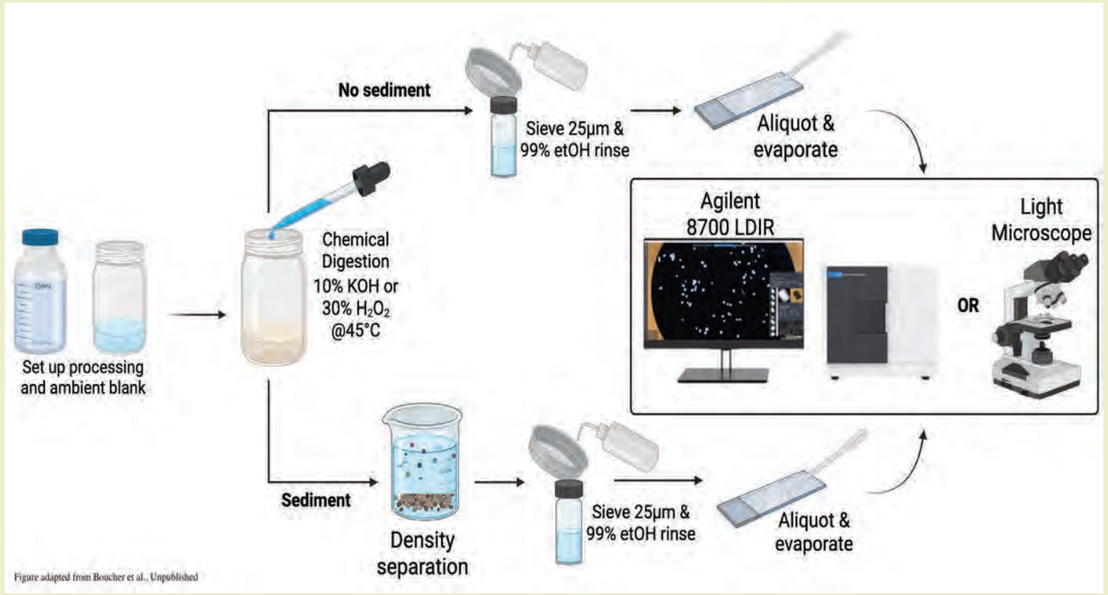
ABSTRACT

BIOTIC AND SPATIAL FACTORS DRIVING MICROPLASTIC ABUNDANCE IN THE GIZZARD OF GREEN-WINGED TEAL (*ANAS C. CAROLINENSIS*) IN HISTORIC ANTEBELLUM RICE FIELDS IN SOUTH CAROLINA

Aruã Yaym de Castro Ferreira
Master's Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Derived from the polymerization of monomers, plastics are synthetic organic polymers whose large-scale production began in 1950. Improper plastic waste management has become a rising problem facing humanity as oceans, waterways, and terrestrial areas all become choked with plastic waste products. Microplastics are introduced into the environment via several anthropogenic activities, such as cloth washing, use of hygiene care products like exfoliants, and industrial by-products (Velis et al., 2017) (Figure 1). Consequently, there has been an increasing concern about microplastics as an emerging pollutant. Microplastics are plastic particles ranging from 1 µm – 5 mm in size, though the absolute lower size limits vary. These microplastics originate as primary or secondary plastics. Primary microplastics are manufactured and include products like exfoliating beads in cosmetic cleansers, plastic microspheres used in biomedical and life sciences research, and industrial abrasives. Secondary microplastics result from the deterioration and fragmentation of larger microplastic pieces





into smaller fragments.

Microplastics are a significant threat to both wildlife and humans. The ingestion of microplastics by organisms can result in physiological and behavioral impairments. Additionally, microplastics can absorb and transport toxic compounds (i.e., PFAS), serving as a vector for these substances within food webs. Coastal ecosystems are particularly vulnerable to microplastics as they receive high input from urban runoff, wastewater discharge, and industrial effluents. Microplastic accumulation in coastal environments can threaten the biodiversity and function of these systems, which are crucial for migratory species and local communities. Historic antebellum rice fields (HARF) in Coastal South Carolina (SC) with origins in the transatlantic slave trade in the 1600s are a crucial habitat for waterfowl. Nowadays, ~33,000 acres of tidal HARFs remain functional and provide habitat for a myriad of waterfowl species. According to Masto et al. (2023) and Hanks et al. (2021), these rice fields are highly utilized by wintering dabbling ducks. Approximately 30% of all dabbling ducks in the Atlantic Flyway winter in the South Atlantic region, particularly in coastal SC. Thus, tidal functional HARFs in SC are a crucial habitat for wintering dabbling ducks in the Atlantic Flyway.

Currently these critical wetlands are under threat from microplastics. Adjacent anthropogenic development has the potential to deposit microplastics in these unique systems, threatening the survival of waterfowl that depend on HARFs. Given these threats, I aim to investigate the presence and concentration of microplastics in the gizzard of Green-winged Teal (GWTE) as a bioindicator for microplastic contamination in SC's HARFs.

The goal of this research is comprised of three objectives: 1) Assess the presence and concentration of microplastics in the gizzard of GWTE in SC's HARFs. GWTE was the most harvested species (n=641) in the SC Department of Natural Resources Waterfowl Management Areas in the 2024-25 hunting season. Consequently, it is an optimal surrogate species, since hunters may be the terminal link in the microplastic trophic pathway. Microplastic presence and concentration will be assessed utilizing chemical digestion with potassium hydroxide (KOH) and hydrogen peroxide (H2O2) paired with the Agilent 8700 Laser Direct Infrared (LDIR) chemical imaging device (Figure 2). 2) Utilize a linear mixed effects model to determine whether microplastic concentration, microplastic type, and polymer type is affected by mass, sex, predominant species, location, watershed, urbanization, and population density. 3) Compare the performance of the Agilent 8700 LDIR to a light microscope for identifying microplastic types and measuring microplastic concentration.

At this point in time, I am chemically digesting the gizzard contents and will begin chemical imaging shortly. Nonetheless, given the findings of Gray et al. (2018) and the tidal nature of coastal HARFs, I predict microplastics will be present in the gizzard of GWTEs. Additionally, I predict synthetic particle polymer types to be congruent with the findings of Boucher et al. (Unpublished), where rubber and polyamide are highly abundant. Furthermore, I predict sex, predominant prey species, urbanization, and population density will significantly influence microplastic abundance. Finally, I predict the light microscope will identify trends in the abundance of microplastics, but it will underestimate

overall abundance.

This research effort would not have been possible without the support of the SC Department of Natural Resources, Southeast Mitigation, Mississippi State University, Nemours Wildlife Foundation, The Wildlife Society, Wetlands Working Group, and the Whitmire Laboratory.

Citations

Boucher, M. N. Unpublished data. Regional Alligator Diet and Ecotoxicology of Contaminant of Emerging Concern in American Alligator (*Alligator mississippiensis*). Clemson University, SC

Gray, A. D., Wertz, H., Leads, R. R., & Weinstein, J. E. 2018. Microplastic in two South Carolina Estuaries: Occurrence, distribution, and composition. *Marine Pollution Bulletin*, 128, 223-233.

Hanks, R. D., Baldwin, R. F., Folk, T. H., Wiggers, E. P., Coen, R. H., Gouin, M. L., ... & Fields-Black, E. L. 2021. Mapping antebellum rice fields as a basis for understanding human and ecological consequences of the era of slavery. *Land*, 10(8), 831.

Masto, N. M., Hsiung, A. C., Kaminski, R. M., Ross, B. E., Kneece, M. R., Wilkerson, G. L., ... & Anderson, J. T. 2023. Waterbird–habitat relationships in South Carolina: implications for protection, res toration, and management of coastal and inland wetlands. *Restoration Ecology*, 31(7), e13956.

Velis, C., Lerpiniere, D., & Tsakona, M. 2017. Prevent Marine Plastic Litter - Now! An ISWA facilitated partnership to prevent marine litter, with a global call to action for investing in sustainable waste and resources management worldwide. Report prepared on behalf of the International Solid Waste Association (ISWA). An output of ISWA Marine Litter Task Force. ISWA September 2017. *Vienna*, pp.75.

Research
ABSTRACT

USING OYSTERS TO AID HABITAT RESTORATION OF SALTWATER IMPOUNDMENTS: A CASE STUDY FROM LITTLE EDISTO ISLAND, SOUTH CAROLINA

Christopher Pettengill
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Background

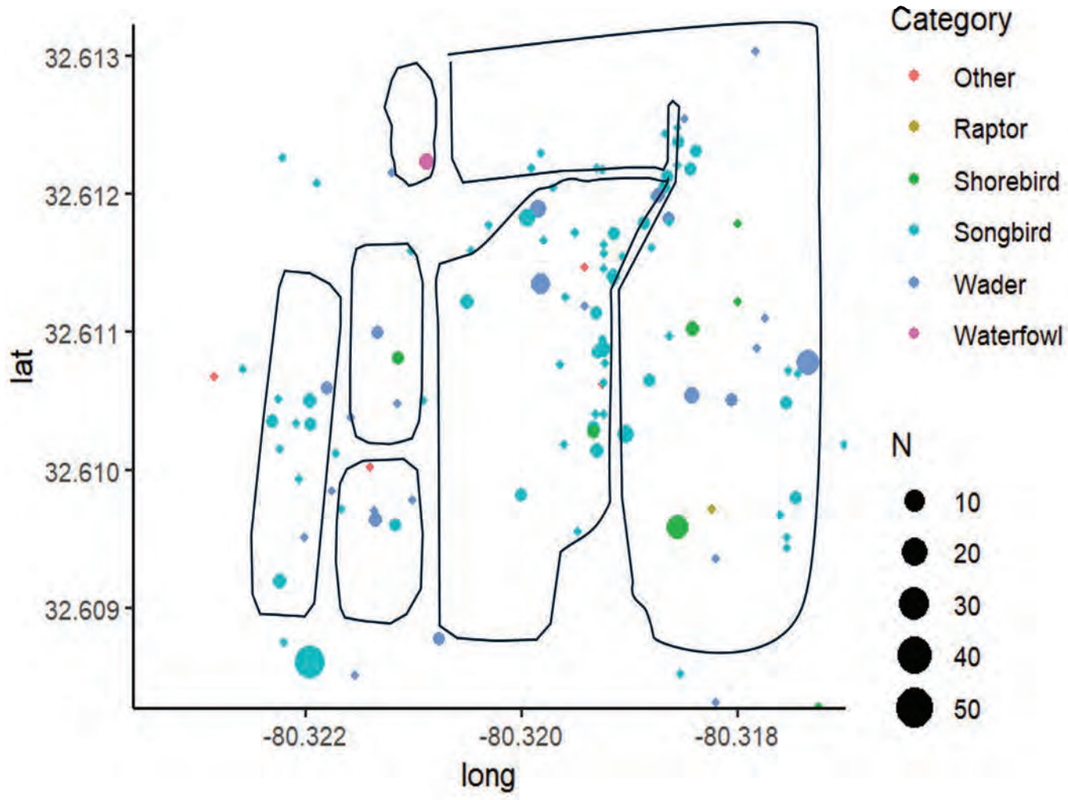
South Carolina's saltmarshes have been heavily modified through impoundments that restrict tidal flow using rice trunks and similar structures. These modifications alter natural hydrology, sedimentation, and habitat accessibility, often reducing ecosystem function. On Little Edisto Island, six impoundments within the Russell Creek Mitigation Bank differ significantly from natural saltmarsh systems. Restoration efforts aim to enhance these impoundments by mimicking natural marsh conditions and increasing ecosystem services through the addition of oyster-supporting structures. Oysters are known to improve habitat quality for fish, invertebrates, and birds by providing food, shelter, and water filtration.

This study compares the ecological conditions of impoundments with nearby natural saltmarsh reference sites to identify locations suitable for oyster colonization and assess how oyster structures may enhance habitat quality. Emphasis is placed on evaluating baseline biological communities and water quality, then monitoring shifts following restoration actions.

Research Objectives

1. Determine organism community composition and abiotic conditions of impoundments prior to restoration
   - Monitor bird activity to assess habitat usage
   - Assess fish community structure and compare to reference marshes
   - Survey vegetation composition and coverage
   - Monitor water quality (salinity, DO, pH, turbidity, nutrients, chlorophyll-a)
   - Evaluate substrate and physical habitat features relevant to oyster colonization

2. Analyze the impacts of oyster colonization on ecosystem services
   - Monitor biotic communities and habitat conditions post-structure deployment
   - Compare impoundments with reference marshes with existing oyster density
   - Quantify changes in services such as biodiversity, water quality, and estimate economic value



Methods
Water samples are collected monthly from each wetted impoundment and processed using EPA protocols for phosphorus, nitrate, and ammonia, as well as total suspended solids and coliform bacteria. Plant surveys occur quarterly along transects, recording species cover within quadrats. Fish sampling is also conducted quarterly using minnow traps, seine nets, and cast nets. Invertebrates are collected via sediment cores, D-net sweeps, and crab traps, and identified in the lab. Bird communities are assessed through monthly transect surveys using GPS, rangefinders, and Distance 7.5 software to calculate population densities.

Results and Preliminary Observations
Oysters are currently limited to a few structures within only two impoundments. In contrast, reference sites with added hard substrates show dense oyster colonization. Nutrient concentrations (phosphate, nitrate, ammonia) are low overall, though higher in summer. Dissolved oxygen declines notably in impoundments with seasonal widgeon grass die-off. Salinity is consistently brackish to marine (23.9–26.97 ppt), while chlorophyll-a concentrations are low (<2 RFU), indicating low phytoplankton abundance.

Plant communities divide clearly between high marsh and low marsh zones, with greater diversity at higher elevations. Fish communities vary by impoundment; those with consistent drawdown are dominated by *Cyprinodon variegatus* and *Fundulus heteroclitus*, while deeper sites host more diverse assemblages. Invertebrates in impoundments are dominated by *Glycera americana*, *Littoraria irrorata*, and *Ilyanassa obsoleta*, with shrimp species more abundant at reference sites. Bird surveys show wetland songbirds concentrate near woody vegetation on berms, while wading birds and shorebirds utilize mudflats depending on tide stage. Common species include *Agelaius phoeniceus*, *Tringa melanoleuca*, *Calidris alpina*, and several *Egretta* and *Ardea* species.

Expected Outcomes
Oysters may not significantly alter water chemistry due

to high tidal exchange, though localized effects may occur. Fish and invertebrate diversity are expected to increase near new structures, as organisms are already colonizing artificial substrates such as data loggers and control structures. Plant community changes are unlikely, though long-term sediment buildup could expand marsh vegetation. Bird communities may remain stable unless major hydrologic changes are made, but fish- and invertebrate-feeding species could benefit from higher prey availability.

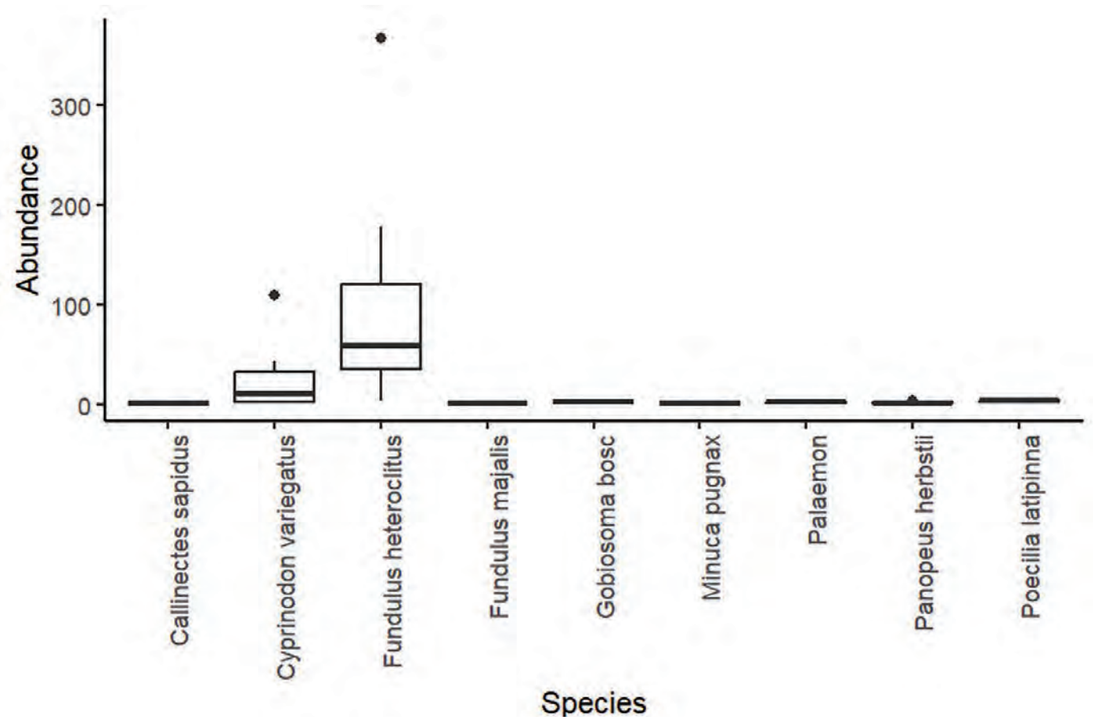
Reference saltmarshes are expected to have higher aquatic biodiversity due to unrestricted access for marine organisms. Bird communities may differ due to limited mudflat at reference sites. Water quality patterns appear most influenced by the tidal creek supplying each site, rather than by internal site characteristics.

Acknowledgements

I want to thank Dr. James T. Anderson for acting as my academic and research advisor for this project. I would also like to acknowledge Rene Brown (master's student) and Keegan Foster (biologist), as they have been significant contributors to the fieldwork of this research. Andrew Hopkins (postdoc) has aided me with my proposal and grant writing.

Funding Sources

- **Southeast Mitigation LLC. Mr. Lee Taylor and Mr. Jeff Grant**
- **South Carolina Wildlife Federation**
- **Society of Wetland Scientists**
- **South Carolina Mitigation Association**



Research

ABSTRACT

INVESTIGATING THE PRESENCE AND HEALTH IMPLICATIONS OF FOUR PFAS IN WOOD DUCK (AIX SPONSA) POPULATIONS ACROSS SOUTH CAROLINA

Jake Shurba
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Introduction:

Per- and polyfluoroalkyl substances (PFAS), or "forever chemicals," are synthetic compounds used in industrial and commercial products for their resistance to heat, water, and oil. Their chemical stability has led to environmental persistence, especially in aquatic systems, where they accumulate in water, soil, and wildlife. In South Carolina, PFAS has been detected in over 100 water bodies, with notable concentrations near military installations that use aqueous film-forming foams. Our research aims to determine how widespread PFAS are in coastal wetlands near military and non-military lands in South Carolina, and what the potential health and ecological risks associated with PFAS accumulation in waterfowl.

Objectives:

1. Establish a baseline dataset of four PFAS (PFOS, PFOA, PFHxS, PFHxA) in soil and water.
2. Assess PFAS exposure in wood ducks by age and sex.
3. Quantify PFAS in plasma, feces, and muscle tissue.
4. Investigate links between PFAS and duck health indicators.
5. Determine maternal transfer via egg albumin.
6. Evaluate potential human health risks from waterfowl consumption.

Methodology:

We will use quantitative, field-based contaminant monitoring and physiological health assessment. Samples will be collected from six coastal sites (military, state, federal, and private lands) and from wood ducks captured via nest boxes (Figure 1), live-trapping, and hunter harvest (Figure 2).

Data Collection:

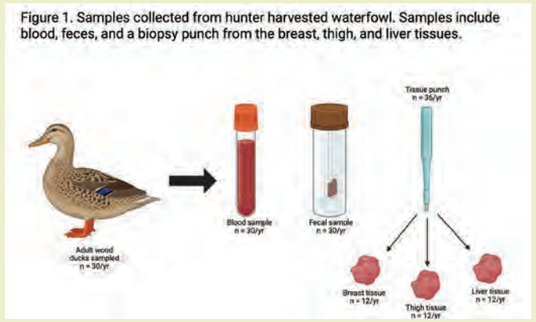
- Environmental: Soil (~100 g) and water (500 mL) samples collected at five random points per site (30 total samples/year for each medium).
- Waterfowl:
  - Live capture: Blood, feces, and morphometrics collected; individuals banded.
  - Hunter-harvested: Breast muscle biopsy, blood, feces collected.
  - Reproduction: Two eggs per nest collected for PFAS in albumin (Figure 3).

PFAS concentrations will be analyzed in all samples. Blood will be evaluated for packed cell volume (PCV), total protein (TP), and immune response via red/white blood cell smears. Plasma will be separated via centrifugation. Data will be analyzed using standard contaminants and hematological assessment protocols.

Anticipated Results:

- PFAS are expected to be present in all sample types, with higher concentrations near military sites.
- Wood ducks are likely accumulating PFAS in tissues, plasma, feces, and potentially transferring them to eggs.
- Differences in PFAS levels are anticipated across age and sex classes.
- Health assessments (PCV/TP and blood smears) may show correlations between PFAS burden and immune or chronic stress indicators.
- Muscle tissue concentrations will inform human exposure risk through consumption.

Figure 1. Samples collected from hunter harvested waterfowl. Samples include blood, feces, and a biopsy punch from the breast, thigh, and liver tissues.



Interpretation:

This study will provide the first comprehensive look at PFAS contamination in wood ducks and their coastal habitats in South Carolina. It addresses critical data gaps related to environmental exposure, reproductive transfer, and health risks for both wildlife and humans. The findings will inform land managers, public health officials, and the hunting community about potential risks associated with PFAS in wetland ecosystems and waterfowl.

Acknowledgements:

I would like to thank the James C. Kennedy Waterfowl and Wetlands Conservation Center and the Forestry and Environmental Conservation Department at Clemson University for taking me on as a PhD student. I would also like to thank the South Carolina Department of Natural Resources, the U.S. Fish and Wildlife Service, and Nemours Wildlife Foundation for providing sampling locations for my field work.

Research

ABSTRACT

UNDERSTANDING WATERFOWL HABITAT RELATIONS WITH ANTEBELLUM RICE FIELDS USING DRONE-BASED SURVEYS IN COASTAL SOUTH CAROLINA

Akshit R. Suthar
Doctoral Student, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Antebellum rice field impoundments in coastal South Carolina are among the most ecologically significant managed wetlands (Fig.1) for waterbirds in the southeastern United States. Originally constructed during the colonial era for rice cultivation, these impoundments now serve as vital stopover and wintering habitats for migratory waterbirds. However, effective management of these wetlands requires an understanding of how different habitat features influence species-specific waterbird abundance. The primary goals of this study were to (1) Estimate species-specific waterbird abundance in rice field impoundments using drone-based surveys and Bayesian N-mixture models and (2) Investigate how impoundment characteristics influence waterbird abundance across different impoundment types.

We conducted repeated drone surveys during the wintering season (Nov-Feb) using a DJI Mavic 3T Enterprise drone (Fig.2) equipped with high resolution color and thermal cameras. Surveys were conducted across multiple impoundments, and species-specific counts were extracted from high-resolution imagery (Fig.3). We used

Figure 2: DJI Mavic 3T Enterprise drone deployed for aerial waterbird surveys in South Carolina's coastal wetlands. Equipped with high-resolution and thermal imaging.

Figure1: Historic wooden trunk (flapgate structure) used for water level management in managed antebellum rice fields along the South Carolina coast. These traditional structures continue to play a vital role in wetland management, supporting waterfowl habitat and maintaining ecological balance.

Figure 3: Aerial view of White Ibises (Eudocimus albus) in a managed impoundment, captured using drone-based surveys in South Carolina's coastal wetlands.

Bayesian N-mixture models to estimate true abundance while accounting for imperfect detection. impoundment characteristics were derived using ArcGIS deep machine learning-based classification of drone imagery.

Results indicated strong variation in species abundance across impoundment types. Green-winged Teal (Fig.4), Gadwall, and Northern Shoveler exhibited the highest abundances in Tidal Functional impoundments, followed by Inland and Tidal Broken types (Fig.5). Submerged aquatic vegetation (SAV) cover had a consistently strong positive effect on abundance for these dabbling duck species (Fig.6). Open water percentage and water level were also positively associated with waterbird abundance, though the strength of association varied by species. Emergent vegetation and impoundment size showed weak or inconsistent effects. Wading birds such as Snowy Egret (*Egretta thula*) and Great Egret (*Ardea alba*) were detected less frequently, with distributions more evenly spread across impoundment types. Integration of thermal imagery with RGB enhanced detection probabilities, especially in densely vegetated or low-contrast areas.

Our study demonstrates that drone-based surveys combined with hierarchical modeling provide reliable estimates of species-specific waterbird abundance. Key

Figure 4: Aerial image of a flock of Green-winged Teal (Anas crecca) foraging in a managed impoundment, showing no disturbance from the drone flying overhead.

habitat variables such as SAV, open water, and water level are important predictors of waterfowl use. These findings offer critical insights into the adaptive management and conservation of South Carolina's antebellum rice fields in the face of environmental change, supporting efforts to preserve these historic and ecologically important wetlands.

Acknowledgements

I gratefully acknowledge the James C. Kennedy Waterfowl & Wetlands Center and Nemours Wildlife Foundation for their graduate research fellowship and logistical support. I thank the Andy Quattlebaum and Blackwell Family Foundation, Ducks Unlimited, and SC Sea Grant for funding support. The Society of Wetland Scientists, Slocum Lunz Foundation, and TWS Wetlands Working Group for student research grants. National Bobwhite and Grassland Initiative, SC Cooperative Fish and Wildlife Research Unit and Folk Land Management, Inc. for technical support and SCDNR staff, managers, and landowners for their permission to survey the properties and invaluable assistance during data collections.

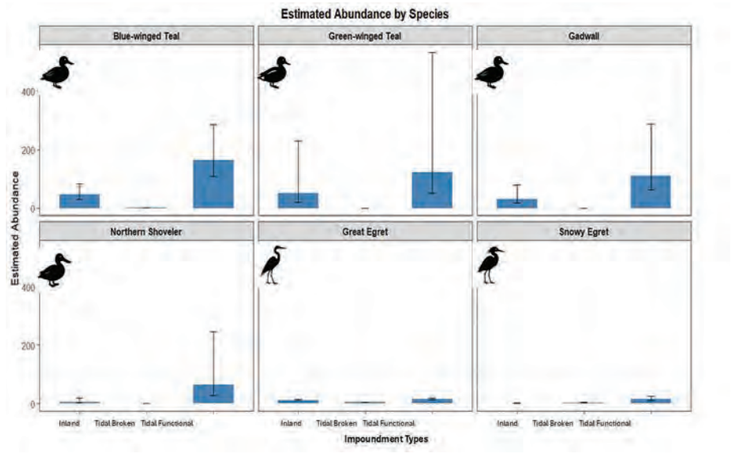


Figure 5: Estimated abundance of selected waterfowl and wading bird species across three impoundment types (Inland, Tidal Broken, and Tidal Functional) in coastal South Carolina using a Bayesian N-mixture model from drone-based surveys,

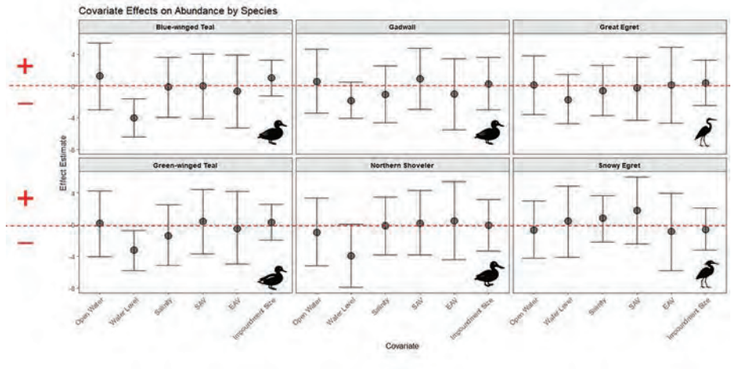


Figure 6: Covariate effects on estimated abundance of selected waterfowl and wading bird species derived from a Bayesian N-mixture model. Effect estimates (points) and 95% credible intervals (bars) are shown for six covariates. Positive values above the red line indicate a positive association with abundance, while negative values indicate a negative association.

Research
ABSTRACT

FLOATING FEASTS: EVALUATING THE NUTRITIONAL MAKEUP AND LIFE HISTORY OF BANANA WATER LILY FOR WATERFOWL MANAGEMENT

Keegan Foster
Wildlife Biologist I, Clemson University
James C. Kennedy Waterfowl and Wetlands Conservation Center

Introduction

Nymphaea mexicana, better known by its common name banana water lily, is a species of lily pad native to the southeastern United States and Mexico. For many years, Jim Hills, owner of Frost Waterfowl Trust, has been cultivating banana water lilies on his property to attract wintering waterfowl to his impoundment. While visual observations of a positive correlation between waterfowl abundance and banana water lily production are apparent on his property, little scientific research is known about this plant regarding its use in waterfowl management. Our goal with this case study is to look at the life history of this plant and see how effective banana water lilies are as a food source when implemented into waterfowl management. Over the course of a year, we aim to see the quantity of food biomass produced, both directly in the form of banana water lily vegetative matter and indirectly in the form of invertebrate associations, as well as the dietary quality of this plant through nutrient analysis. Additionally, we want to quantify how much banana water lily waterfowl consumes and which parts of the plant prove to be the most desirable for wintering waterfowl.

Methodology

Our study site for this project is Ingleside Plantation. Ingleside Plantation is a historic antebellum rice field. To this day, water levels and salinity in a 19-acre impoundment are manipulated using a historic rice trunk. This impoundment is used to grow banana water lilies exclusively.

For this project, we have categorized banana water lilies into three potential food components: seeds, tubers, and rhizomes. To determine the amount of underground biomass (tubers and rhizomes) waterfowl are consuming, three different levels of protective exclosures were devised (no exclosure, partial exclosure, and full exclosure). In each exclosure, four underground biomass samples were taken prior to waterfowl migration. Another four samples of underground biomass were collected post-waterfowl hunting season. All samples were weighed in the lab after each round of sampling. Underground biomass values generated will be used to calculate the quantity of underground biomass consumed by waterfowl during the winter season.

Biomass of banana water lily vegetation (tubers, rhizomes, and seeds) was collected during the fall of 2024 using a core sampler and seed pod pouches. Invertebrate biomass of benthic, aquatic, aerial invertebrates was conducted using a core sampler, uprooting entire banana water lily plants, and UVA light traps respectively.

To test the nutritional content of seeds, tubers, and rhizomes, three samples of each potential food component were taken. This type of sampling will be conducted three times over the course of one year (fall 2024, summer 2025, and fall 2025), to track potential nutrient changes.

On the last day of waterfowl season, hunter-harvested birds from the study site were collected. Individual ducks were identified to species level, sexed, and aged. Esophagus and gizzard samples from each duck were cut open and stored in vials of 70-75% ethanol to stop the digestive process.

Results

We expect the underground biomass within full exclosure plots to be higher than the biomass of both partial exclosure plots and no exclosure plots due to the protection against herbivory of all large aquatic vertebrates. Using the differences in biomass from samples collected prior to waterfowl season compared to post-waterfowl season, we can calculate the amount of biomass consumed by waterfowl.

Discussion

Due to the nature of the harvested waterfowl gizzard and esophagus collection, we expect there to be limited usable data. Originally, this hunter-harvested data was going to provide preliminary insights into the parts of banana water lily waterfowl consumed. However, irregular weather conditions caused the most frequently seen waterfowl species at this study site, ring-necked ducks, to be absent entirely upon harvest day. Based on the food production and nutrient analysis we generate from this case study, we hope to garner interest in conducting a proper diet study on waterfowl consumption of banana water lilies.

Furthermore, we hope to use this case study as a steppingstone for other researchers to compare banana water lilies' growth across a variety of more complex systems. Specifically, looking at how it fares in polyculture impoundments, as well as comparing labor intensity of banana water lily cultivation to that of other commonly cultivated waterfowl food sources.

Acknowledgments

I express my gratitude to Jim Hills. Without his continued enthusiasm, support, and property access, this project would not have been a possibility. I also thank Jim Anderson for his supervision and expertise in this project. Lastly, I would like to thank all the staff, students, and interns from the Baruch Institute of Coastal Ecology and Forest Science who have contributed their time and labor in both the field and lab portions of this project.

Research
ABSTRACT

COMPARATIVE GENETICS AND MOVEMENT PATTERNS OF WILD AND GAME-FARM MALLARDS IN THE SOUTHEASTERN UNITED STATES

Crystal Anderson & Margaret Jensen
Wildlife Biologist, James C. Kennedy Waterfowl and Wetlands Conservation Center

Project Overview

Mallards (*Anas platyrhynchos*) are one of the most widely distributed ducks in the world, long valued by people for food, hunting, and conservation. In North America, their numbers rose sharply in the 20th century, and they now rank among the most harvested ducks in the Atlantic Flyway. Part of this increase stemmed from large-scale releases of captive-raised mallards, with hundreds of thousands released annually along the eastern seaboard during the last century. While these introductions bolstered hunting opportunities, they also came with trade-offs: interbreeding between farm-raised and wild mallards has blurred genetic distinctions, potentially reducing the adaptability of wild populations and threatening their long-term resilience.

In response, the James C. Kennedy Waterfowl and Wetlands Conservation Center at Clemson University, working with the South Carolina Waterfowl Association, Palmetto Waterfowl, and the University of Texas at El Paso, launched a multi-year research effort to investigate how released mallards interact with their wild counterparts. This work combines genetic testing, movement ecology, and predator-prey observations to answer a fundamental conservation question: what are the ecological and genetic consequences of mixing farm-raised and wild mallards in South Carolina?

Progress to Date

Fieldwork began in summer 2025 with banding of farm-raised mallards. Every bird received a USGS leg band, establishing long-term tracking through national recovery networks.

This fall, the project is expanding into several new phases:

- Nanotags: Lightweight tags will allow researchers to detect the presence or absence of marked birds at release sites through automated receiver networks.
- GPS-GSM Transmitters: Twenty-five mallards will carry satellite transmitters that record and relay fine-scale movements, allowing the team to examine flight distances, dispersal, and habitat use across the flyway.
- Genetic Analysis: All birds handled in fall will be bled to compare genetic signatures of wild, farm-raised, and hybrid individuals, providing baseline measures of genetic integrity.

Next Steps

In spring 2026, trapping will focus on wild mallards to expand the dataset. Captured birds will be banded, sampled for DNA, and fitted with GPS transmitters to track seasonal and long-distance movements. Blood samples collected across refuges and hunt club properties will be sequenced in partnership with the Lavretsky Lab at UTEP, offering high-resolution insight into the proportion of pure versus hybrid lineages.

Motus tower

Anticipated Outcomes

This study is expected to highlight key contrasts among mallard groups:

- Movement Ecology: Captive-origin birds may show shorter, less consistent movement patterns compared to wild birds.
- Genetics: Farm-raised mallards are predicted to carry lower genetic diversity, a warning sign for adaptability.

Data will be analyzed using a combination of statistical approaches (e.g., ANOVA, regression) to compare group differences in behavior and movement, and nesting success.

Broader Impact

The implications extend far beyond South Carolina. If released mallards consistently dilute the genetic integrity of wild populations or perform poorly in the wild, conservation strategies may need to adapt, potentially incorporating breeding programs that restore pure North American mallard lineages. By linking genetic studies with ecological data, this research will provide managers with the knowledge needed to safeguard healthy and resilient waterfowl populations in the Atlantic Flyway.

Research

ABSTRACT

ASSESSING THE IMPACT OF SOLAR FARMS ON WATERBIRDS: A LITERATURE REVIEW OF THE ECOLOGICAL INTERACTIONS AND HABITAT ALTERATIONS

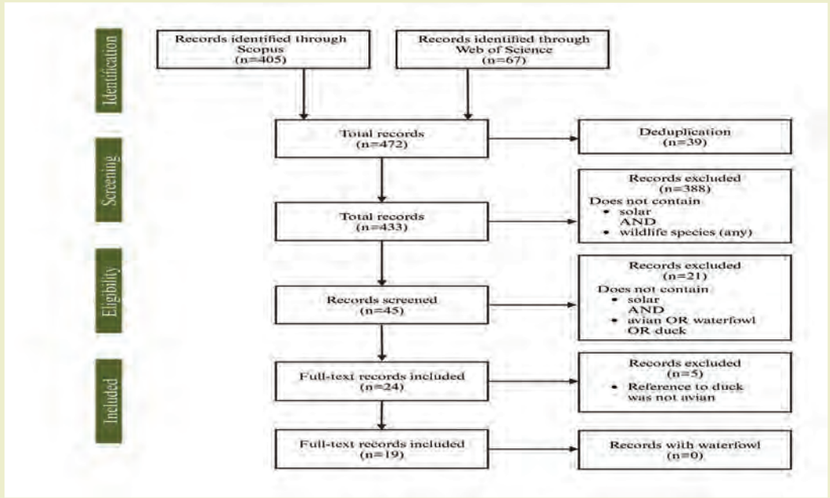
Crystal M. Anderson
Doctoral Student, Clemson University
James C. Kennedy Waterfowl And Wetlands Conservation Center

As global efforts intensify to reduce greenhouse gas emissions and combat climate change, solar energy has emerged as a key renewable resource. Its benefits, such as reduced air pollution, low carbon output, and decreasing costs, make it a compelling alternative to fossil fuels. However, the rapid expansion of solar infrastructure has prompted new concerns about its potential ecological impacts, particularly in sensitive habitats such as wetlands.

A recent journal publication from the James C. Kennedy Waterfowl and Wetlands Conservation Center presented a comprehensive global literature review to assess how solar farms affected abiotic and biotic components of ecosystems, with a special focus on migratory waterbirds and wetland systems (Figure 1).

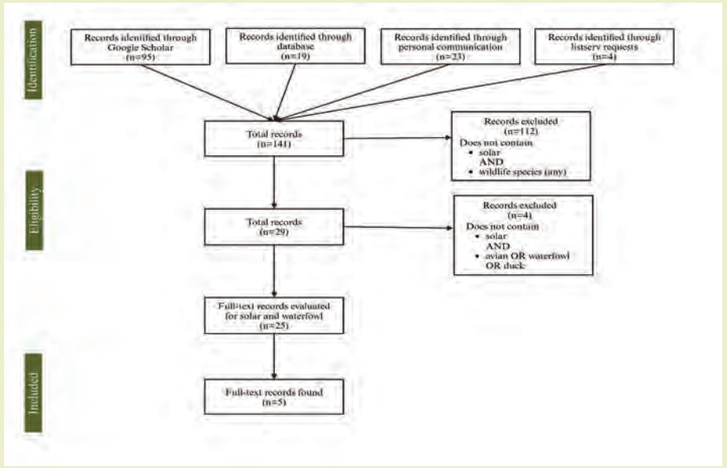
The review synthesized findings from 141 sources and revealed that while solar farms offered ecological benefits such as improved soil health, increased pollinator abundance, and localized cooling, they also posed risks that included habitat fragmentation, altered hydrology, microclimate shifts, and potential toxic contamination from panel materials (Figure 2:3). One of the most pressing concerns was the risk to avian species. Studies showed that large-scale solar installations could disrupt bird migration routes, confuse waterbirds through the "lake effect" (where reflective panels were mistaken for water), and increase collision-related mortality.

Only five studies mentioned waterbirds, all focused solely on mortality in arid regions. None directly addressed waterfowl behavior, habitat use, or broader ecological consequences in wetland ecosystems, demonstrating the urgent need for expanded, region-specific research. Migratory birds relied heavily on wetlands as stopover and breeding sites. Loss or degradation of these habitats due to solar development could lead to reduced species richness, altered migration patterns, and economic losses in regions dependent on waterfowl-related recreation and hunting.



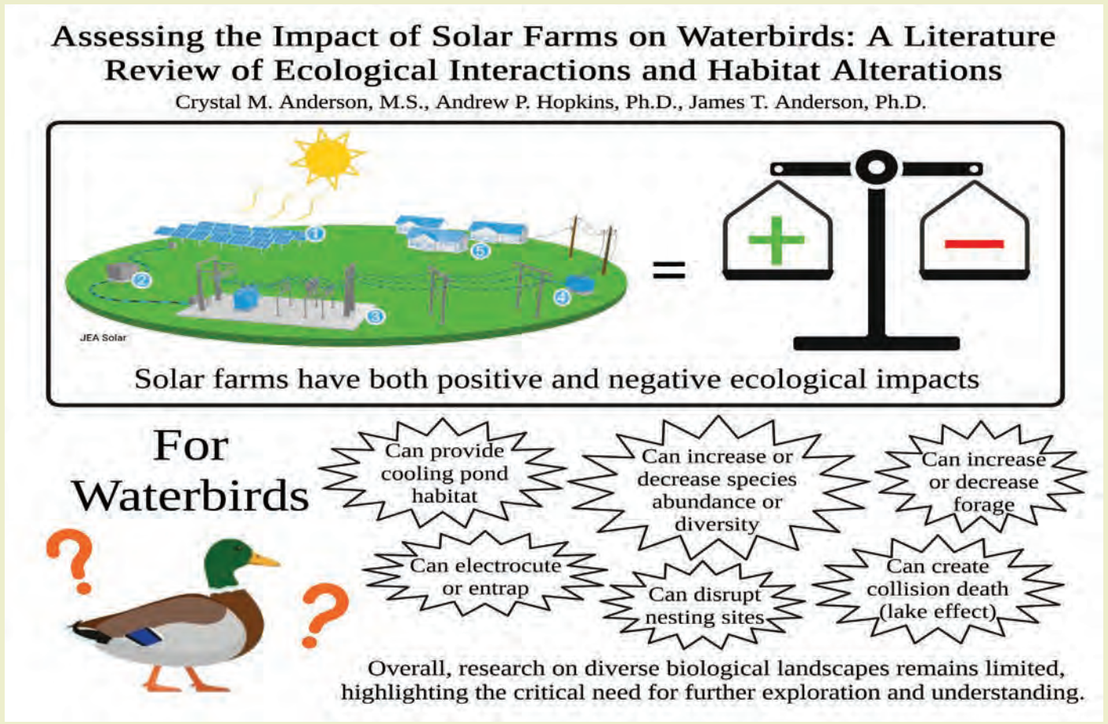
The paper also evaluated the environmental trade-offs of solar technology. While solar lacked the CO_2 emissions of traditional energy sources, current photovoltaic panel designs included heavy metals and chemicals that could leach into soils and waterways, especially at the end of the panels' life

cycles or if damaged. Furthermore, solar installations disrupted soil structure, affected plant community dynamics, and altered the moisture and temperature regimes essential for wetland biodiversity.



To balance the benefits of clean energy with conservation priorities, the study proposed a range of mitigation strategies. These included implementing wildlife-friendly panel designs, using UV-patterned glass to deter bird collisions, minimizing fencing to maintain habitat connectivity, and incorporating native vegetation and artificial structures to support wildlife. Technologies such as single-axis tracking systems were also identified as tools that could reduce ecological disruption while improving energy efficiency.

Ultimately, the research called for a shift toward more site-specific environmental assessments and the adoption of conservoltaic principles that integrated conservation goals into solar development. This was especially vital in coastal and wetland areas, where solar infrastructure had the potential to cause disproportionate harm to waterbird populations and critical habitats. Proactive planning, interdisciplinary research, and community-inclusive decision-making were deemed essential for ensuring that the global push for renewable energy did not come at the cost of irreplaceable ecosystems.



Creative INQUIRY

DRONES, DUCKS, AND DECISIONS: HISTORICAL RICE FIELDS AND TIDAL WETLANDS OF COASTAL SOUTH CAROLINA

Instructors: Akshit Suthar and Crystal Anderson

Image 1: *Creative Inquiry students and instructors during a coastal field trip at Nemours Wildlife Foundation, learning the ecology and management of antebellum rice fields. The group gained hands-on experience with innovative monitoring technologies and discussed the social dimensions of wetland conservation.*

At Clemson University, we offer the Drone, Ducks, and Decision Support course as part of our Creative Inquiry program. This undergraduate course provides students with hands-on experience in fieldwork (Image 1), data analysis, social dimension surveys, and the use of drone technology in wetland conservation and waterfowl habitat management.

Students in the course learn about the rich history of antebellum rice fields in coastal South Carolina (Image 2). These historic landscapes, once used for rice cultivation, now serve as crucial habitats for waterfowl and other wildlife. Understanding their transformation over time gives students an understanding of how these ecosystems can be managed for both ecological and societal benefits.

Students are learning Federal Aviation Administration (FAA) rules for safe drone operation, ensuring students become responsible drone pilots. They also gain experience using tools like DotDotGoose to manually count waterfowl using aerial images captured by drones. They are learning drone mission planning for habitat surveys and flight paths (Image 3), selecting appropriate altitudes to minimize disturbance to waterfowl while

Image 2: *Nemours Wildlife Foundation biologist Beau Bauer explaining habitat management practices for waterfowl to students, highlighting the vital role of historic wooden trunk structures in regulating water levels within managed rice fields.*

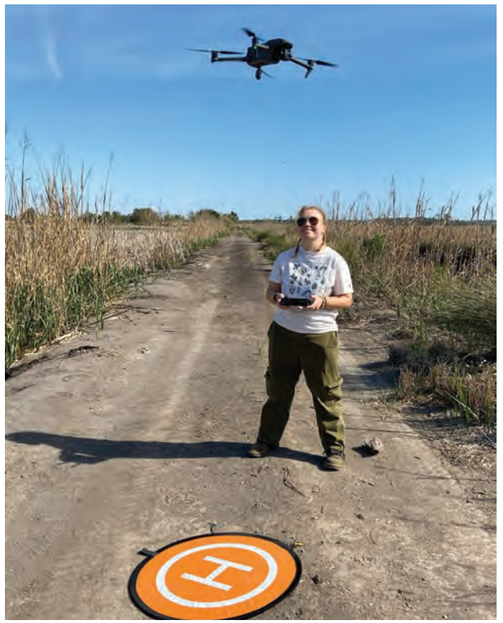


Image 3: *Students learning to operate drones, design flight plans, and conduct aerial surveys for waterfowl monitoring as part of hands-on training in innovative wildlife research methods.*

collecting high-quality data. These skills are essential for monitoring waterfowl populations and conducting ecological surveys non-invasively.

The course emphasizes the importance of the social dimensions of conservation. This course allows students to engage with local stakeholders, such as landowners, wildlife agencies, and conservation organizations, to understand the diverse perceptions and values associated with wetland management. This allows them to develop a well-rounded perspective on conservation challenges and the need to balance ecological and social goals.

Students also gain experience in analyzing data to inform decision-making. By participating in real-world projects, students develop practical skills that prepare them for careers in environmental consulting, research, and wildlife management.

Students had the opportunity to author and co-author two poster presentations, showcasing their research and findings at The Annual Focus on Creative Inquiry (FoCI) and The Clemson Student Research Forum 2025. These experiences allowed students to communicate their work to a broader academic audience, strengthening their skills in scientific communication and interdisciplinary collaboration.

Outreach & EDUCATION

SOUTHEASTERN WILDLIFE EXPOSITION

SHARING SCIENCE, SPARKING CURIOSITY

02/14/2025

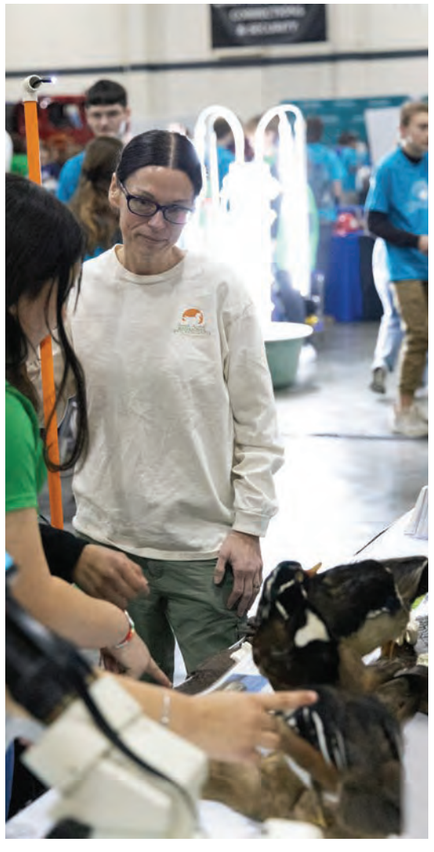
A dedicated group of students volunteered at the Southeastern Wildlife Exposition (SEWE) in Charleston, a premier wildlife and conservation event that annually attracts around 40,000 attendees, a remarkable growth from the mere 5,000 visitors and 100 exhibitors in its inaugural year. Their involvement allowed them to serve as scientific ambassadors, engaging the public, sharing research, igniting curiosity, and inspiring the next generation of wildlife enthusiasts. Through this experience, the students exemplified how hands-on outreach at community events like SEWE transform ecological science into an accessible, vibrant conversation.

WILD ABOUT WETLANDS

INSPIRING FUTURE CONSERVATIONISTS AT P2P

01/15/2025

Graduate students from the James C. Kennedy Waterfowl and Wetlands Conservation Center teamed up with the Baruch Institute of Coastal Ecology and Forest Science to spark curiosity at the Pathways 2 Possibilities (P2P) Career Expo. This hands-on event, hosted by the Bunnelle Foundation, invited 8th graders to explore diverse career paths through interactive exhibits and real-world demonstrations. By showcasing careers in conservation science, students learned how their passions for nature, wildlife, and the environment could grow into meaningful professions, all while aligning with state and national education standards.



BRINGING WETLANDS TO LIFE

AT BULLS BAY NATURE AND HERITAGE FESTIVAL

05/17/2025

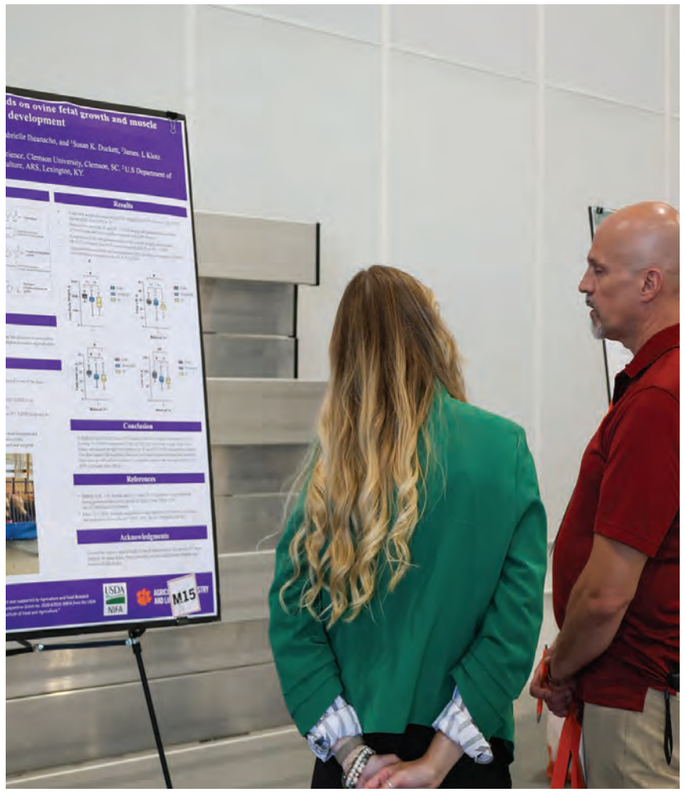
The Kennedy Center, in collaboration with the Baruch Institute of Coastal Ecology and Forest Science, hosted an interactive tent at the Bulls Bay Nature and Heritage Festival in Awendaw. Kennedy Center students connected with community members by sharing their ongoing research and highlighting the vital role wetlands play in supporting biodiversity and protecting coastal ecosystems. The tent featured engaging, hands-on activities for children, exploring the impacts of plastic pollution on the environment, and discovering the unique behaviors and habitats of waterfowl. Events like this strengthen community awareness of local conservation issues, inspire curiosity in future scientists, and foster a shared commitment to protecting South Carolina's natural heritage.

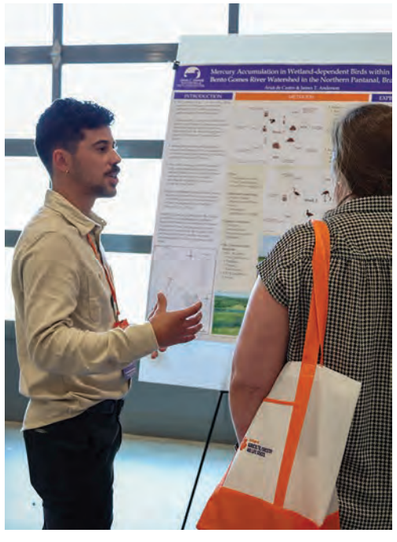
COLLEGE OF AGRICULTURE, FORESTRY, AND LIFE SCIENCES

3RD GRADUATE RESEARCH SYMPOSIUM

08/19/2024

Graduate students from the Kennedy Center showcased their cutting-edge research at the CAFLS 3rd Graduate Research Symposium. Ph.D. student Akshit Suthar presented a 3MT titled "Advancing Waterbird Conservation: A Comparative Study of Drone and Ground Surveys in Antebellum Rice Fields of Coastal South Carolina," highlighting innovative methods to improve conservation strategies. Ph.D. student Oluwatobi Olaniyi delivered a 3MT on "Socio-Environmental Resilience: Decision Support for Tidal Rice Field Restoration," offering tools to guide restoration efforts that benefit both communities and ecosystems. M.S. student Arua De Castro presented a poster on "Mercury Accumulation in Wetland-Dependent Birds Within the Bento Gomes River Watershed in the Northern Pantanal, Brazil," shedding light on critical environmental issues impacting wildlife in one of the world's most vital wetland regions.





SHOWCASING WETLAND LEADERSHIP

AT THE TIGERS FOR GREEN INNOVATION SUMMIT

07/03/2025

Members of the James C. Kennedy Waterfowl and Wetlands Conservation Center participated in Clemson University's Tigers for Green Innovation Sustainability Summit, reinforcing our role as a leader in wetland and wildlife conservation. Director Dr. Jim Anderson delivered a plenary talk on wetland conservation, spotlighting the Center's work with waterfowl, wetlands, and wetland-dependent wildlife. Kennedy Center students also represented the Center and the Baruch Institute of Coastal Ecology and Forest Science at the event's exhibitor tables, engaging with attendees on the importance of conservation science. Participation in high-profile sustainability events like this strengthens the Kennedy Center brand, builds valuable connections, and amplifies our impact in advancing conservation goals locally, regionally, and beyond.

THE WILDLIFE SOCIETY

31ST ANNUAL CONFERENCE

10/27/2024

Ph.D. student Akshit Suthar attended and presented his research at The Wildlife Society's 31st Annual Conference in Baltimore, Maryland. During the symposium session on Drone Applications for Wildlife Research, Management, and Conservation, he presented his work titled "Are Drones the Future of Waterbird Surveys? Comparing Drone and Ground-based Survey Methods to Count Waterbirds in Coastal South Carolina." His research explores the innovative use of drone technology to enhance wildlife surveys, offering new ways to study waterbird populations and habitats. The conference provided an excellent opportunity for Akshit to connect with professionals in the field and gain valuable insights from leading experts.

WETLANDS, WATERBIRDS, AND

THE NEXT GENERATION OF SCIENTISTS AT SEAFWA

12/09/2024

At the 78th SEAFWA Conference, our graduate students and director, alongside graduate students from the Baruch Institute of Coastal Ecology, proudly showcased the Kennedy Center's impactful research. Ph.D. student Akshit Suthar presented a case study highlighting his innovative drone-based techniques for surveying waterbirds in historic rice fields. Director Dr. Jim Anderson shared the work of Kennedy Center alumnus Nick Masto, focusing on waterfowl and shorebirds in wetlands. In addition, our Creative Inquiry–Clemson undergraduate students presented four posters, demonstrating their growing contributions to wetland and waterfowl research.

CONNECTING CULTURE & CONSERVATION

IN THE LOWCOUNTRY

12/16/2024

Creative Inquiry undergraduate students from Clemson University traveled to coastal South Carolina on their first of two trips, for an immersive experience that combined wildlife science, advanced technology, and cultural history. Students learned to conduct drone-based waterfowl surveys, explored wetland ecology, and engaged with the rich heritage of the Gullah Geechee community. Through hands-on fieldwork and cultural exchange, they developed practical skills, expanded their perspectives on conservation, and gained a deeper appreciation for the links between natural resources and cultural identity. This distinctive experience, featured in Clemson University's News Magazine, highlights the value of integrating science, technology, and heritage to prepare the next generation of conservation leaders.

COLLEGIATE SPORTSMAN AND WOMEN'S CLUB

10/23/2024

Akshit Suthar, a Ph.D. student at the James C. Kennedy Waterfowl and Wetlands Conservation Center, was invited by the Clemson Collegiate Sportsman and Women's Club to share his expertise on waterfowl conservation and management in South Carolina and to present his research on waterbird habitat relationships in antebellum rice fields using drone-based aerial surveys. He also highlighted ongoing projects at the Kennedy Center, encouraging students to get involved through internships and volunteer opportunities. A big thank you to the club for hosting such an engaging and inspiring talk.

FLYING INTO THE FUTURE DRONE TECHNOLOGY FOR WATERFOWL SURVEYS

02/20/2025

Akshit Suthar, a Ph.D. student, was invited to speak at Nemours Wildlife Foundation's Friends of Nemours event, themed "A Bird's-Eye View: Drone Science with a LIVE Demonstration." He presented his research on waterbird habitat use in South Carolina's historic rice fields and highlighted how drone technology is revolutionizing wetland science. Using drones equipped with color and thermal cameras, Akshit demonstrated how researchers can detect and count birds more accurately while reducing disturbance. He conducted a live flight demonstration, streaming the drone's view to a large screen so participants could observe waterfowl in real time through both color and thermal imagery, offering a compelling look at the future of ecological monitoring and conservation.

FROM RICE FIELDS TO RESEARCH: STUDENTS MERGE HISTORY, WILDLIFE, AND TECHNOLOGY

03/27/2025

The Ducks, Drones, and Decision Support Creative Inquiry-Clemson students spent time at Nemours Wildlife Foundation, exploring the rice impoundments in search of waterfowl and other wetland wildlife. Each student had the opportunity to pilot a drone and practice survey techniques used by Akshit Suthar for waterfowl population counts.

The team deployed acoustic monitoring devices to capture the calls of secretive marsh birds. Students had the opportunity to learn the rich history of the region's iconic historical/Antebellum rice fields. Beau Bauer, Wildlife Biologist at Nemours, shared insights into the transformation of these historic landscapes into critical waterfowl habitats, from learning about traditional water level management structures like trunk (wooden flap gates) and dikes to understanding the complexities of current habitat management practices. The students got a firsthand look at the interplay between history, conservation, and innovation.

FROM CLASSROOM TO FIELD: RECRUITING TOMORROW'S RESEARCHERS

04/01/2025

Our graduate students attended the Clemson Undergraduate Job Fairs to recruit UPIC and Creative Inquiry students for summer positions in wetlands, waterfowl, and ecological research. These events ensured that graduate researchers had the support needed for field and lab work, while giving undergraduates the opportunity to apply their skills in real-world conservation projects. By working alongside experienced scientists, undergraduates gained hands-on experience, explored potential career paths, and assessed whether research was the right fit for their future.

INSPIRING THE NEXT GENERATION OF WILDLIFE BIOLOGISTS

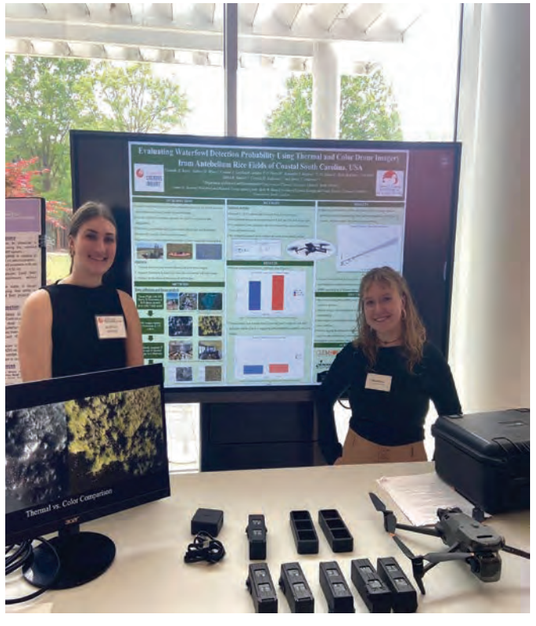
04/04/2025

Staff Biologist and doctoral student Crystal Anderson visited Plantersville Digital Immersion Charter School to share what it's like to work as a wildlife biologist and the educational paths that can lead to a career in the field. Through engaging discussions, students learned how science, conservation, and curiosity can shape a future dedicated to protecting wildlife and the environment.

TAKING FLIGHT: CREATIVE INQUIRY STUDENTS SHOWCASE WATERFOWL RESEARCH

04/10/2025

The Drone, Ducks, and Decision Support Creative Inquiry team, led by Akshit Suthar and Crystal Anderson, presented their innovative work at the 2025 Focus on Creative Inquiry (FoCI) event at Clemson University. Showcasing two posters, Waterfowl Populations and Human Dimensions: Hunter Satisfaction Survey and Evaluating Waterfowl Detection Probability Using Thermal and Color Drone Imagery from Antebellum Rice Fields of Coastal South Carolina, the team demonstrated how cutting-edge drone technology and social science integration can advance wetlands and waterfowl research. Their projects highlight Clemson students' ability to combine technical innovation with ecological insight to address complex conservation challenges.



WORKSHOP ON WATERFOWL MANAGEMENT IN SOUTH CAROLINA'S LOWCOUNTRY

10/07/2024

The James C. Kennedy Waterfowl and Wetlands Conservation Center recently co-sponsored a workshop on waterfowl management in South Carolina's Lowcountry organized at the Nemours Wildlife Foundation in collaboration with Clemson Extension. James (Jim) Anderson, Director of the Kennedy Center and Endowed Professor of Waterfowl and Wetland Ecology shared an insightful overview of the Center's ongoing research projects and the latest exciting updates. Akshit Suthar, a PhD student at the Kennedy Center, presented his cutting-edge work on using drone technology to manage and understand waterfowl habitats in the antebellum rice fields of coastal South Carolina. Andrew Hopkins (Post-Doc Fellow), Keegan Foster (Wildlife Biologist I), Oluwatobi Olaniyi (PhD Student), and Maiya Duncan (PhD Student) from Kennedy Center joined the workshop and participated in the discussions.

TAKING FLIGHT IN WATERFOWL SCIENCE: TRAINING AT ROCKEFELLER WILDLIFE REFUGE

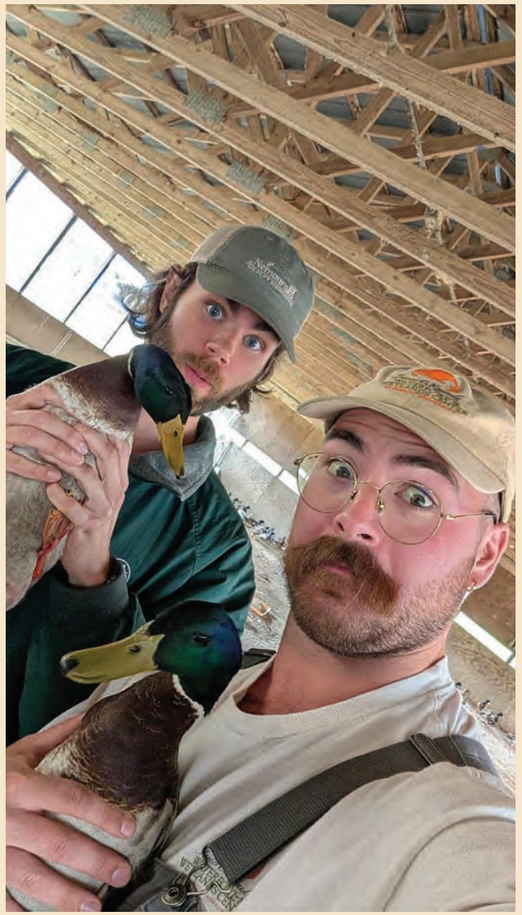
03/10/2025

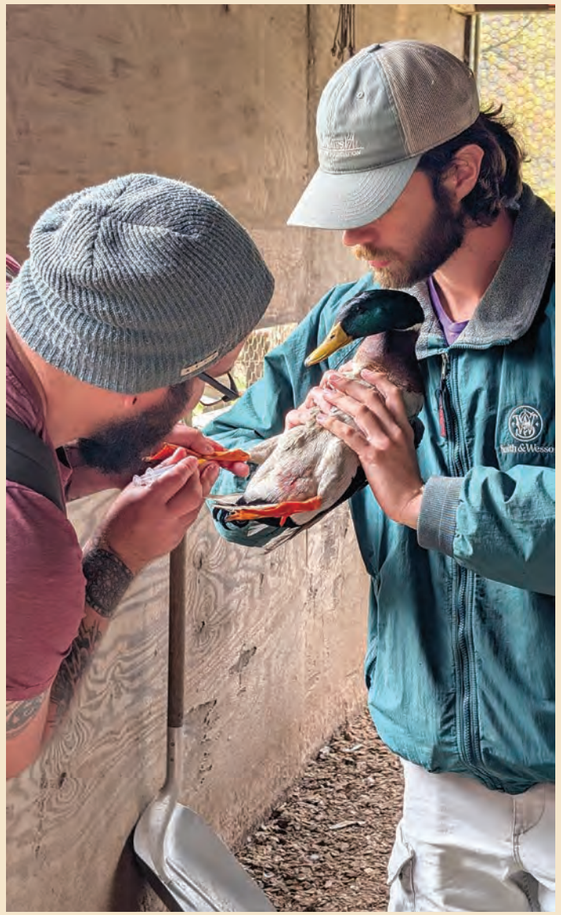
Doctoral student Akshit Suthar was one of only 15 students selected from across North America to attend the prestigious Waterfowl Capture, Banding, and Analyses Workshop at Rockefeller Wildlife Refuge in Louisiana. Led by experts from the Louisiana Department of Wildlife and Fisheries, the University of Minnesota, the Delta Waterfowl Foundation, and the U.S. Geological Survey Bird Banding Laboratory, the workshop provided immersive training in both field and classroom settings. Akshit gained hands-on experience with essential techniques, from rocket nets to bait traps, while learning how banding data drives science-based waterfowl population management. This experience strengthens his expertise and advances the mission of the James C. Kennedy Waterfowl and Wetlands Conservation Center.

BUILDING SKILLS FOR THE FUTURE OF WATERFOWL RESEARCH

03/16/2025

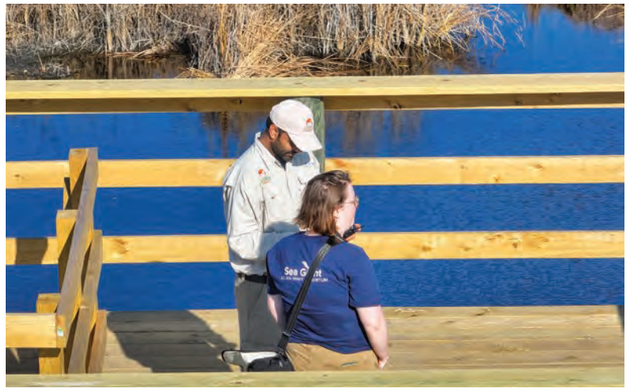
Staff Biologist Keegan Foster and Postdoctoral Researcher Dr. Andrew Hopkins recently participated in a two-week waterfowl banding workshop hosted by the University of Texas El Paso's Lavretsky Lab. The training ensured they are fully equipped to meet ethical IACUC standards while advancing their technical expertise. Participants gained hands-on experience in banding, blood sampling, and DNA analysis. These are skills that will support innovative, high-quality research at the James C. Kennedy Waterfowl and Wetlands Conservation Center and strengthen its commitment to cutting-edge, ethically sound wildlife science.





SHAPING THE FUTURE OF SOUTH CAROLINA'S HISTORIC RICE FIELDS

02/18/2025



The S.C. Sea Grant Consortium team visited the James C. Kennedy Waterfowl and Wetlands Conservation Center to learn about an ongoing research project exploring the future of South Carolina's managed antebellum rice fields. Led by Dr. James T. Anderson, the project is developing a decision support tool to help land managers balance habitat conservation, cultural heritage, and coastal resilience in the face of sea level rise and increasing restoration costs. During the visit, Ph.D. student Akshit Suthar demonstrated trunk gate operations and showcased drone-based waterfowl surveys conducted at Nemours Wildlife Foundation.

BUILDING REEFS, RESTORING SHORES

02/02/2025

In February, Christopher Pettengill and Rene Brown, joined a volunteer event at Coastal Carolina University in Conway, South Carolina, hosted by the South Carolina Oyster Recycling and Enhancement (SCORE) program. Together with other volunteers, they built several manufactured wire reef habitats filled with oyster shells, which will be deployed along the South Carolina coastline to support restoration efforts. SCORE leads many of the state's "living shoreline" projects, using these reefs to enhance coastal resilience and habitat.

STRENGTHENING COMMUNITIES AND SAFE-GUARDING KNOWLEDGE FOR A RESILIENT COAST

03/01/2025

Staff Biologist and doctoral student Crystal Anderson recently partnered with members of the Baruch Institute of Coastal Ecology to help the Waccamaw Indian People build a traditional longhouse. This collaboration extended beyond construction, preserving Indigenous knowledge, fostering mutual respect, and strengthening ties between scientists and local communities. Protecting cultural heritage is closely linked to environmental stewardship, as traditional ecological knowledge offers time-tested strategies for sustaining wetlands and adapting to change. By working alongside the Waccamaw Indian People, the project supported both cultural and ecological resilience, ensuring future generations inherit healthy wetlands and the wisdom to protect them.

GROWING RESILIENCE: COMMUNITY GARDENS AND POLLINATOR CONSERVATION IN MCCLELLANVILLE

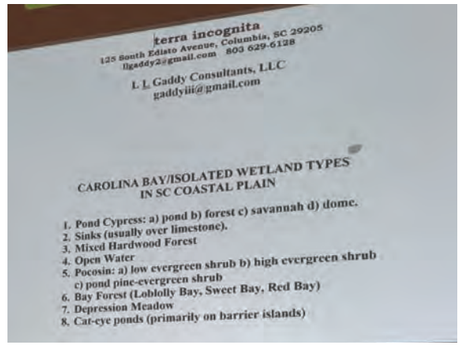
03/08/2025

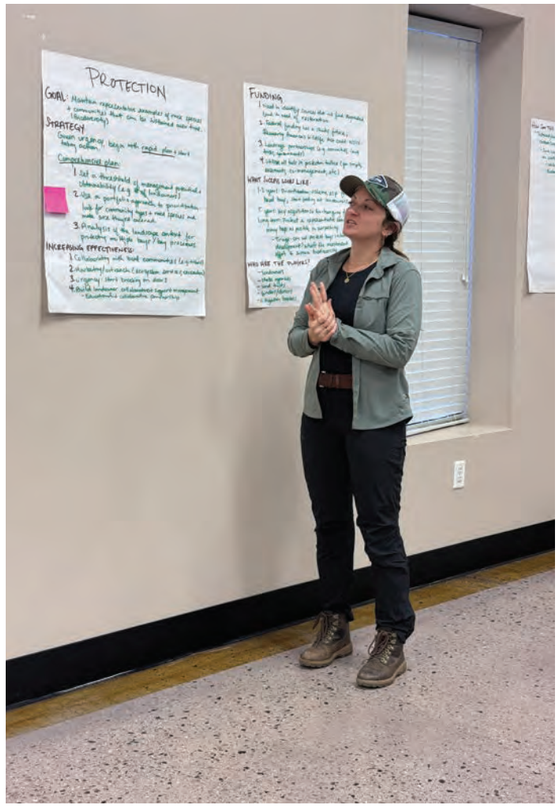
In collaboration with the McClellanville community surrounding Hampton Plantation, Crystal Anderson's research project is transforming a shared vision into reality with the installation of a 20-bed community garden. The initiative strengthens local resilience and self-efficacy by providing space for fresh food production while serving as a living classroom for pollinator education. By connecting residents to the vital role of pollinators in both agriculture and wetland ecosystems, the project fosters environmental stewardship and community engagement. Ongoing monitoring of pollinator diversity in nearby wetlands will deepen understanding of these critical species and help guide future conservation strategies that benefit both people and wildlife.

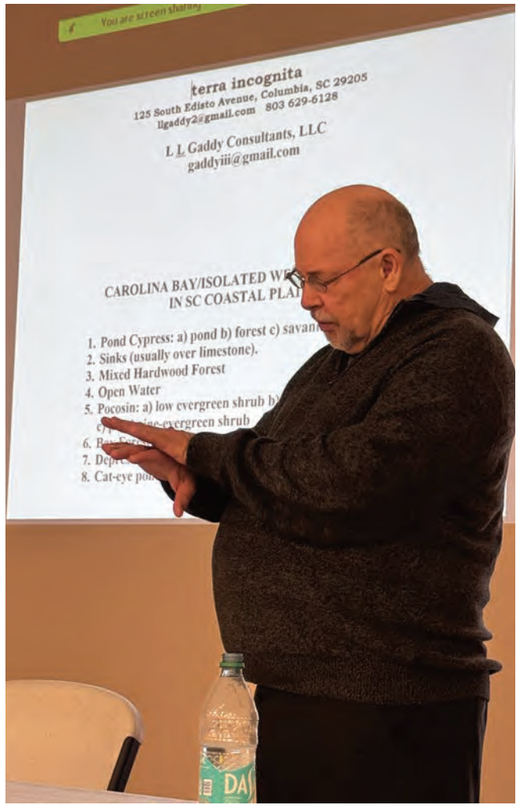
FROM CHALLENGES TO SOLUTIONS: THE FUTURE OF CAROLINA BAYS

03/10/2025

Graduate students and staff biologists Scott Binger, Keegan Foster, and Crystal Anderson attended the inaugural Carolina Bays Working Group meeting, focused on conservation and preservation efforts across North and South Carolina. Carolina Bays are ecologically significant wetlands that provide habitat for at-risk, rare, and endangered species, while offering exceptional research opportunities. The team engaged in interactive planning sessions designed to spark innovative thinking, address the many challenges these unique ecosystems face, and explore practical solutions for ensuring their long-term protection.







MICROPLASTICS UNDER THE MICROSCOPE: EARTH WEEK WITH THE KENNEDY CENTER

04/26/2025

Kennedy Center master's students Aruã Yaym and Dorothy joined The Earth Pantry in Augusta to celebrate Earth Week and promote awareness of microplastic pollution. They engaged the community in conversations about the sources and types of microplastics that enter the environment, then led a data-driven trash clean-up to help address the problem locally. Participants also had the chance to examine microplastics under a microscope, gaining a firsthand look at these often-overlooked particles that are pervasive in our surroundings.

FROM PAST TO FUTURE: CLEMSON PH.D. STUDENTS ADVANCE RICE FIELD CONSERVATION

01/04/2025

Congratulations to Ph.D. students Akshit Suthar and Tobi Olaniyi for being featured in the Jan/Feb 2025 issue of Ducks Unlimited magazine for their research on antebellum rice fields, waterfowl, and decision-support tools.

Akshit Suthar uses advanced monitoring technologies, including drones and Autonomous Recording Units (ARUs), to study waterfowl and secretive marsh birds in South Carolina's historic rice field impoundments. Originally built in the pre-Civil War era, these landscapes now serve as critical habitat for wildlife. His work showcases how these areas sustain biodiversity and how emerging technologies can improve ecological monitoring.

Tobi Olaniyi is developing a decision-support tool to guide the sustainable management of these rice impoundments. By integrating environmental data, such as hydrologic conditions and waterfowl use, with socioeconomic factors, his tool provides actionable insights for restoration and conservation—especially in addressing challenges like sea level rise.


CONSERVATION CONTINENT

New Research Will Help Conserve South Carolina's Historic Coastal Impoundments

The coastal landscape of South Carolina has been transformed through historic rice farming in the Lowcountry region. Beginning in the 1670s, cypress-tupelo swamps were cleared, diked, and leveed for rice cultivation along the elevational gradient from the uplands to the lowlands. In the 1700s, tidal rice cultivation was established, which created tidal impoundments that used freshwater inflows, predictable tides, and water-management devices, called trunks, for rice production. After the Civil War, the rice industry in South Carolina collapsed. Although some rice farming continues to exist in the Lowcountry, most rice impoundments have been abandoned and are unmanageable due to degraded infrastructure, storm damage, and changing tidal amplitude caused by sea-level rise.

Despite these historical landscape alterations, the inland freshwater and tidal impoundments still provide valuable wetland functions, including improved water quality, groundwater recharge, storm protection, and wildlife habitat. To make more informed conservation and restoration decisions concerning these wetland systems, research is needed to quantify the value of these habitats to waterfowl and other wildlife, to understand biological relationships associated with management that can maximize wetland productivity and diversity, to predict system sustainability and resilience in response to future environmental changes (including sea-level rise and storm frequency, among others), and to address the socioeconomic factors that are essential to successful conservation programs.

Clemson University and Ducks Unlimited have partnered to address this important and complex issue. "We are working with Dr. Jim Anderson, director of the James C. Kennedy Waterfowl and Wetlands Conservation Center at Clemson University, on this research project that will hopefully give us some insight on potential restoration activities and management options to maximize the wetland value of South Carolina's historic rice fields," said Dr. Aaron Pierce, DU's director of conservation science and planning.

Dr. Anderson and his two doctoral students, Akshit Suthar and Oluwatobi Olaniyi, will investigate relationships among waterfowl species, impoundment characteristics, hydrological conditions, and management regimes. Information gathered through the project will help researchers develop a risk-benefit matrix and decision support tools to inform conservation plans for what remains of the state's historical rice impoundments, benefiting regional wildlife and all South Carolinians for years to come.

This critical research would not be possible without funding from the Andy Quattlebaum and Blackwell Family Foundation.

"The Andy Quattlebaum and Blackwell Family Foundation are proud to be involved with this initiative, for we value the heritage and diverse ecological systems in the antebellum rice fields," said Ed Dennis, the foundation's executive director. "We hope that through this study, landowners can use the research-based decision support tool to further develop their land-management plans and preserve or improve the historical habitat."

In addition to the gift from the Andy Quattlebaum and Blackwell Family Foundation, the study is supported by a grant from the South Carolina Sea Grant Consortium and Clemson's James C. Kennedy Waterfowl and Wetlands Conservation Center.

Akshit Suthar, a doctoral student at Clemson University, uses a drone to help assess the conservation potential of historical rice impoundments in South Carolina's Lowcountry.

DRONES: PORTRAIT OF A TRAILBLAZING WETLANDS RESEARCHER

02/26/2025

The American Ornithological Society's Faces of AOS series recently spotlighted Doctoral student, Akshit Suthar, from the Clemson University Waterfowl and Wetlands Conservation Center, for their pioneering integration of autonomous technologies and inclusive leadership in ornithology. Highlighted were Akshit's innovative use of drones and passive acoustic monitoring to enhance waterbird surveys in wetlands, and their commitment to community building through co-chairing the AOS Student Affairs Committee.

FROM CLASSROOM TO COAST: STUDENTS LINK TECHNOLOGY, HISTORY, AND COMMUNITY

04/28/2025

Our Creative Inquiry course, Historical Rice Fields and Tidal Wetlands of Coastal South Carolina: Drones, Ducks, and Decision Support, was featured in the 2025 CAFLS Dean's Report! Students took their learning beyond the classroom and used drone technology to conduct a waterfowl aerial survey, explore the cultural importance of antebellum rice fields, and engage directly with the Gullah-Geechee community.

the experience

TAKING LEARNING TO NEW HEIGHTS

Students blend technology, culture and research in a groundbreaking course on South Carolina's coastal wetlands

Experiential learning is key to helping students tackle real-world challenges by turning classroom lessons into practical skills. Doctoral students Akshit Suthar and Crystal Anderson embraced this idea when they created the course "Historical Rice Fields and Tidal Wetlands of Coastal South Carolina: Drones, Ducks and Decision Support." The course gives undergraduates the chance to step out of the classroom and gain hands-on experience in the field, blending learning with real-world problem-solving.

Students visited sites such as the Tom Yawkey Wildlife Center, Hobcaw Barony, and Sandy Island, engaging directly with the Gullah-Geechee community to explore the cultural and historical significance of antebellum rice fields. They applied cutting-edge technology by conducting South Carolina's first waterfowl drone survey, capturing aerial data to monitor wildlife populations. Additionally, they developed social surveys to assess hunter satisfaction with current regulations, integrating ecological, technological and social science approaches. A standout achievement of the course was that all students earned their drone pilot license, equipping them with a valuable certification for future careers.

The program not only gave students a comprehensive understanding of coastal wetlands management but also allowed them to contribute to ongoing research at the James C. Kennedy Waterfowl and Wetlands Conservation Center. With plans for students to be listed as co-authors on future publications, this course is a prime example of how CAFLS prepares students for impactful careers through experiential learning opportunities that combine academic rigor with real-world impact.

▲ The Creative Inquiry class captured this "bird's-eye" view of the pristine salt marsh at Hobcaw Barony, Georgetown, S.C. during their class trip.

▼ Ethan Cashwell of the Pickens County Library System uses a Clemson miniature museum to show Pre-K students insects that are native to South Carolina.

MAKING BUGS COOL

Inspiring young minds to see the big impact of bugs

Insects play a crucial role in our environment, and Clemson entomology students are eager to share this with young learners. They've created miniature museums—compact drawers containing about 100 insect specimens, including beneficial insects, pests and invasive species—to educate Pre-K through 5th-grade students. These mini museums come with lesson plans and fact sheets, making it easy for teachers and librarians to introduce the fascinating world of insects to children.

Funded by sponsors like the Entomological Society of America Chrysalis Fund, the mini museums are free to public schools and libraries in South Carolina. The Pickens County Library reports the exhibits are popular with patrons of all ages, sparking curiosity and helping dispel myths about insects.

The project, managed by Clemson students with faculty guidance, promotes interactive learning and fosters appreciation for insects' ecological importance. Teachers and organizations can apply for free mini-museums to enhance science education across the state.

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ADVISORY COUNCIL GATHERS TO CHAMPION CONSERVATION

07/10/2025

On Thursday, July 10, 2025, the Annual James C. Kennedy Waterfowl and Wetlands Conservation Center Advisory Council Meeting was held at the scenic Baruch Institute of Coastal Ecology. Board members came together to hear presentations from student researchers, who showcased their innovative work on waterfowl ecology, wetland conservation, and pressing environmental challenges. The Kennedy Center Board plays a crucial role in guiding the Center's research and ensuring continued leadership in conservation science. We are deeply grateful for their ongoing support, insight, and commitment to our mission.

Student PROFILES

AKSHIT SUTHAR

Ph.D. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

Akshit Suthar is a dedicated wildlife biologist with a strong passion for avian ecology, wetland conservation, and the application of innovative technologies in wildlife monitoring. Born and raised in rural India, Akshit is pursuing his Ph.D. under Dr. Jim Anderson at the James C. Kennedy Waterfowl and Wetlands Conservation Center, Clemson University. His dissertation research focused on "Understanding Waterbird Habitat Relations with Antebellum Rice Fields Using Drones and Autonomous Recording Units in Coastal South Carolina, USA".

Akshit's journey into ecological research began during his undergraduate studies, where he worked on projects including nest box ecology of House Sparrows, Human - Sloth Bear conflicts and bear ecology, and an ecological assessment of Mugger Crocodiles. In 2014, he joined a regional organization in Gujarat's arid Kachchh landscape, leading environmental education and community-based biodiversity conservation projects focused on wetlands and waterfowl. His efforts enabled active participation from local communities and stakeholders, ensuring sustainable conservation outcomes.

In 2016, Akshit moved to central Gujarat to work with the Gujarat Ecological Society, contributing to ecological profiling, state environment atlases, and human-animal conflict mitigation projects. Notably, he rediscovered Smooth-coated Otters in Gujarat and conducted the first systematic survey on their status and conservation threats, earning recognition from the International Otter Survival Fund with the "Otter Oscar-2019" award in the research category. As a Wadhvana Wetlands Advisory Committee member in Gujarat, India, he played a vital role in securing RAMSAR recognition for the site.

Beyond research, Akshit has served as a visiting faculty at Gujarat University and S.P. University, inspiring future environmentalists and conservationists. Akshit has authored or co-authored over 14 peer-reviewed scientific publications and currently serves as a reviewer for six national and international journals. His expertise spans quantitative ecology, ecological modeling, species distribution modeling, acoustic and drone-based wildlife surveys, community-based conservation, and wetland habitat restoration. He co-chairs the American Ornithological Society's Student Affairs Committee. He is an active member of organizations such as the International Union for Conservation of Nature, The Waterbird Society, The Society for Conservation Biology, The Wildlife Society, and the Society for Wetland Scientists.

ARUÃ YAYM DE CASTRO FERREIRA

M.S. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

Aruã Yaym was born and raised in Brazil near the Pantanal, the largest contiguous freshwater wetland in the world. At the age of 3, he first visited his godfather's lodge and cattle ranch in the Northern Pantanal. From then on, it became a tradition to visit the breath-taking landscapes of the Pantanal during school breaks and holidays to assist with cattle ranching, and tours at the lodge. By the age of 15, he had developed a burning passion for the Pantanal, and its traditions. Giving rise to his ultimate career goal, to become a wetland ecologist conducting research that supports local communities, conservation, sustainable development, and sustainable management in the Pantanal. By the time he turned 18 years old, he met a group of senior ecology scientists from the US (Alan Haney, Steve Apfelbaum, and John Rogner) while working at his godfather's lodge. Recognizing Aruã Yaym's passion for the Pantanal and ecology, they guided him in pursuing his dream to become a wetland ecologist. With their help, he ventured to the U.S in 2018, in pursuit of high-quality education.

In 2022 he received his bachelor's degree in forestry focused on ecosystem restoration and management from the University of Wisconsin – Stevens Point. Throughout his undergraduate career, he engaged in several undergraduate research projects focused on soil science and plant taxonomy, where he gained valuable experience in developing and conducting scientific research. Following his B.S graduation, Aruã Yaym became a field research technician under a PhD student from Mississippi State University, stationed in South Carolina. Where they researched food availability in historic rice field tidal impoundments for dabbling ducks, as well as their diet. Aruã Yaym joined the James C. Kennedy Waterfowl and Wetlands Conservation Center as a M.S student and graduate research assistant in the spring of 2024. He is currently working on his thesis entitled "Biotic and Spatial Factors Driving Microplastic Abundance in the Gizzard of Green-winged Teal (Anas c. carolinensis) in Historic Antebellum Rice Fields in South Carolina". Additionally, Aruã Yaym will utilize a linear mixed effects model to determine whether microplastic concentration and polymer type is affected by landscape-level variables (i.e., location, population density, urbanization) and biological variables (i.e., weight, sex). Aruã Yaym will also compare the performance of the Agilent 8700 Laser Direct Infrared chemical imaging to a light microscope for identifying microplastic types and measuring microplastic concentration.

Finally, apart from research, Aruã Yaym enjoys many activities in the great outdoors such as fishing, kayaking, hunting, birdwatching, and hiking. Alternatively, while indoors he enjoys reading novels and manga, playing RPG video games, Dungeons & Dragons, and watching TV series.

CHRISTOPHER PETTENGILL

Ph.D. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

Christopher Pettengill is a Ph.D. student in Wildlife and Fisheries Science working with Dr. Jim Anderson at the Kennedy Waterfowl and Wetlands Conservation Center. His research focuses on community ecology and the ecosystem functions and services of wetlands, with a particular interest in how these processes respond to disturbance.

Christopher's fascination with wetlands began in childhood, exploring ponds, creeks, and lakes near his grandfather's home. This early curiosity about invertebrates, fish, and plants grew into an academic passion. As an undergraduate at the State University of New York, College at Brockport, he assisted graduate students with research on plant communities in forests, grasslands, and wetlands, and conducted his own independent study examining the relationship between aquatic invertebrate diversity in streams and riparian vegetation.

He continued to develop his expertise during his master's studies at the University of Alabama, where he gained extensive experience in aquatic insect identification, water quality monitoring, and fieldwork in challenging environments. His thesis research examined the effects of beaver dam removal on freshwater insect communities, further shaping his interest in how ecological processes respond to human and natural disturbances.

At Clemson, Christopher's doctoral research investigates the economic value of ecosystem services provided by oysters in a salt marsh restoration project on Little Edisto Island, South Carolina. His work combines abiotic monitoring, such as water temperature, salinity, conductivity, pH, and nutrient concentrations, with comprehensive biotic surveys. He assesses fish communities using traps and nets, samples benthic invertebrates with cores and D-nets, conducts vegetation transects with quadrats, and monitors bird activity across habitat types. By comparing data collected before and after restoration interventions, Christopher's project will contribute to refining methods for assessing salt marsh restoration success.

This work has been made possible through the cooperation of the landowner and Southeastern Mitigation LLC, who have provided both funding support and valuable local expertise. For Christopher, salt marsh ecology is a new and exciting field, and he is eager to learn from those with long experience working in these environments.

Beyond his academic pursuits, Christopher enjoys spending time outdoors, particularly nature walks, fishing, kayaking, and gardening.

DOROTHY ALDRIDGE

M.S. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

Dorothy Aldridge is a M.S. student co-advised by Dr. Stefanie Whitmire and Dr. Thomas Rainwater with a deep passion for wetland ecosystems. Her research will focus on modeling climate influence on the discharge and distribution of PFAS and microplastics into coastal wetlands. She will work closely with doctoral student Miriam Boucher, utilizing contaminant data from alligator stomach and tissue samples. Her project will spatially integrate contaminant data with climate variables including sea level rise, precipitation, and flood risk to identify wetland systems most at risk.

Before starting at Clemson University, Dorothy received her B.S. in Ecology and Evolutionary Biology and her B.A. in Environmental Studies from the University of California, Santa Cruz. While at UCSC, she undertook several herpetology-focused projects, including evaluating the use of anurans in freshwater toxicology assessments and modeling climate extinction risk for two paedomorphic salamander species. Following her undergraduate studies, she worked as a biologist in environmental consulting, conducting tidal salt marsh restoration in the San Francisco Bay Estuary. During her time in consulting, Dorothy conducted invasive plant and endangered marsh bird surveys for the California Coastal Conservancy's Invasive Spartina Project. She managed the photo point monitoring program, led field crews, mentored seasonal biologists, and cemented her interest in protecting sensitive wetland habitat. She is interested in adaptive restoration strategies and working with low country communities adjacent to wetlands.

Dorothy recently moved to South Carolina with her elderly rabbit, Ziggy, and is excited to explore the Southeast. She has a love for herpetology and for most activities requiring waders or headlamps. When she is not waist deep in mud, Dorothy enjoys crochet, backpacking, trail running, ecological poetry, open water swimming, and mint chip ice cream.

JACOB SHURBA

Ph.D. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

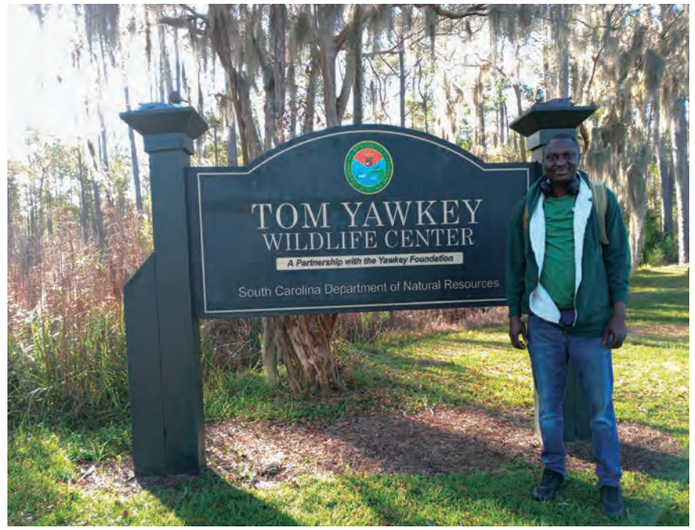
Jake Shurba is a Ph.D. student advised by Dr. Jim Anderson, coming in with a strong interest and passion for wildlife health. His background is as a wildlife disease ecologist with a strong passion for studying the relationships between pathogens and migratory waterfowl in the southeastern United States. His research at the Kennedy Center will focus on the potential relationships between per- and polyfluoroalkyl substances (PFAS; "forever chemicals") migratory waterfowl, specifically wood ducks (Aix sponsa), along the coast of South Carolina. He will additionally be investigating any potential health implications that PFAS may have on waterfowl.

Jake received his B.S. in Wildlife Ecology Research and Management with an emphasis in wildlife disease ecology from the University of Wisconsin–Stevens Point in 2018 and migrated south to work on a pilot study investigating wood duck nesting ecology through Clemson University. Following the successful pilot study, he matriculated to Clemson as a graduate student where he got his M.S. studying wood duck reproductive and disease ecology. After graduating from Clemson, he worked as a disease diagnostician at Auburn University studying parasites and diseases of fish. In 2023 he began work as a wildlife disease ecologist at the University of Georgia Southeastern Cooperative Wildlife Disease Study. In this role, Jake acted as a laboratory manager and researcher studying the epidemiology of avian influenza virus throughout the southeast.

Besides research, Jake has a strong passion for mentorship, teaching, and science communication. He feels that clear and direct communication with the public about the work we do as scientists is the best way to keep them informed and makes science more accessible for everyone. Following graduation, Jake wants to continue working in academia to teach the next generation of disease ecologists. In his free time, Jake enjoys trying new recipes in the kitchen, reading in his hammock, talking science and spending time with his partner (who is also a scientist) and their two cats.

OLANIYI OLUWATOBI

Ph.D. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center



Olaniyi Oluwatobi is a dedicated wildlife biologist at Clemson University and a Ph.D. student in the James C. Kennedy Waterfowl and Wetlands Conservation Center. His dissertation project "Development of a Decision Support Tool for Sustaining Antebellum Rice Fields on South Carolina's Atlantic Coast, USA" utilizes geospatial technologies with machine learning methods and socio-environmental modeling to enhance waterfowl conservation and adaptive wetland management.

He received his Master of Technology in Wildlife Management degree from the Federal University of Technology, Akure, Nigeria. He obtained his postgraduate remote sensing and GIS certifications from the University of Twente in the Netherlands and Kwame Nkrumah University of Science and Technology in Ghana. His academic development began with a solid base in ecological monitoring and conservation planning while he pursued his passion for environmental solutions through data analysis.

Olaniyi has spent ten years working in wildlife biology through impactful projects across Africa, Asia and Europe. As an Assistant Professor and researcher in Nigeria, he conducted field-based investigations about wetland bird habitats and their degradation and climate-related impacts. His most crucial career experience came during his postdoctoral fellowship with the Third World Academy of Science at Universiti Putra Malaysia, where he applied geospatial methods to aid avian conservation in tropical wetlands. The experience developed his interest in merging contemporary technological methods with traditional ecological knowledge.

Several international awards have honored his work, including the Worldwide Fund for Nature (WWF) Prince Bernhard Scholarship and the A.G. Leventis Foundation Grant. As a conservation science advocate, Olaniyi actively engages with worldwide networks, including the Society for Conservation Biology, the Society of Wetland Scientists, and the Environmental Science Without Borders Program at the University of California, Los Angeles, USA.

Olaniyi devotes his passion to understanding how wetland ecosystems maintain their resilience against human interference and climate change. He aims to create novel conservation methods that harmonize ecological preservation with social and economic factors. His time at Clemson University marks an essential stage in his dedication to wildlife research and collaborative science and his leadership of worldwide conservation projects.

RENE BROWN

M.S. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

Rene Brown is a graduate research assistant and master's student at Clemson University, pursuing a degree in Wildlife and Fisheries Biology. She holds a Bachelor of Science degree in Biology from Allen University in Columbia, South Carolina. Her current thesis project concise of two chapters and are titled 1. "Assessing the Baseline Ecological Conditions of an Abandoned Shrimp Farm Before Restoration in Little Edisto Island, SC." And "Decomposition rates of Black Needlerush (Juncus roemerianus) and Saltmarsh Cordgrass (Sporobolus alterniflorus) leaf litter in an impounded salt marsh". This research aims to establish baseline water quality, vegetation composition, and fish community data for future restoration success at a former shrimp aquaculture site.

Rene's passion for wildlife biology was sparked by her childhood experiences on her grandfather's livestock farm in Jamaica, where she spent time observing animal behavior and catching small river fish to keep in a homemade aquarium. These early explorations inspired a curiosity about how different species interact with their environments and how ecological systems function.

Her journey in wildlife biology has included both academic and field experiences. As an undergraduate, she conducted research on microRNA biogenesis in corn and presented her findings to the university's Board of Trustees. She later volunteered at Hope Zoo and interned with the Caribbean Coastal Area Management Foundation, gaining hands-on experience in wildlife husbandry and environmental conservation. These formative experiences shaped her commitment to conservation research and inspired her to pursue graduate studies.

The most impactful experience of Rene's wildlife biology career thus far has been her fieldwork at the S-161 restoration site on Little Edisto Island. There, she collects ecological data across six impoundments, studying vegetation patterns, fish diversity, and water quality trends. Working under the guidance of expert mentors and contributing to a long-term restoration effort has sharpened her skills in experimental design, data analysis, and ecological monitoring.

This work has reaffirmed her desire to pursue a career as a biologist and habitat restoration, focusing on the intersection of science, policy, and community-based conservation.

Rene enjoys playing soccer with her friends, gardening, and watching Animal Planet series.

SCOTT BINGER

Ph.D. Student, James C. Kennedy Waterfowl and Wetlands Conservation Center

Scott is a Ph.D. student at the James C. Kennedy Waterfowl and Wetlands Conservation Center, advised by Dr. James Anderson. Raised near Chicago and inspired by the Cook County Forest Preserves, Scott developed an early passion for wildlife and pursued his undergraduate degree at Southern Illinois University (SIU) after community college.

At SIU, he became interested in ecological interactions and worked as a technician in a freshwater ecology lab. His research included studies on fish, amphibians, and aquatic invertebrates, with a focus on parasites and their responses to environmental change. He continued in the same lab for his M.S., examining how phosphorus enrichment affects parasite populations and developing bioenergetic models of parasite growth. As Scott saw how a single, isolated group of interactions could have a strong impact on an ecological system, he began to want to think bigger in scope about complex systems in ecology. Southern Illinois also shaped an interest in wetland systems for Scott—visits to the Cache River wetlands were his first exposure to large-scale wetlands ecology and he was fascinated with the animal and plant diversity present in these areas.

Scott's interest in landscape-scale ecological change brought him to Clemson University in fall 2024. His current research focuses on the biodiversity of Carolina Bay wetlands—unique habitats in South Carolina impacted by human disturbance. He is sampling macroinvertebrates, frogs, birds, and vegetation and creating a wetland disturbance gradient to develop indices of biotic integrity. These tools will inform management strategies across different wetland sites. Scott's fieldwork has helped him to gain a deeper understanding of the biology of these systems and has also allowed him to foster relationships between the Kennedy Center and stakeholders throughout the state. He is looking forward to continuing to collect and analyze data about these complex systems in hopes of improving conservation efforts in South Carolina and beyond.

Outside of research, Scott enjoys hiking, biking, fishing, playing and recording music, attending concerts, and cheering on Clemson's sports teams.

Student
AWARDS & ACHIEVEMENTS

Student
AWARDS & ACHIEVEMENTS

We are pleased to announce a wide range of fellowships, assistantships, scholarships, research awards, and other scholarly honors earned by Kennedy Center undergraduate and graduate students during 2024–2025. Students across the Center received competitive support from university, state, regional, and national programs, demonstrating strong academic performance, impactful research, and dedication to waterfowl and wetland conservation.

Students are the future waterfowl and wetland managers, biologists, and researchers who will shape conservation efforts in South Carolina and beyond. Through high-quality training and mentorship at the Kennedy Center, we are preparing the next generation of wetland and waterfowl stewards and celebrating the achievements they are already making in the field.

Congratulations to all our students for their current and future accomplishments.

DOROTHY ALDRIDGE
M.S. Student

Dorothy Aldridge was awarded the **South Carolina Mitigation Association Scholarship** in recognition of her strong academic performance and commitment to conservation. This **$2,000** award supports her continued development as an emerging environmental professional.

CRYSTAL ANDERSON
Ph.D. Student

Crystal Anderson earned three competitive awards this year: a $**750 Clemson Graduate Student Government** award, a **$750 Charleston County Native Plant Society** award, and a **$4,000 Pollinator Pathways Creative Inquiry Research** award. These achievements highlight her leadership in graduate education, community engagement, and her growing contributions to native plant and pollinator conservation efforts.

SCOTT BINGER
Ph.D. Student

Scott Binger received a **$750 Clemson Graduate Student Government** award, acknowledging his strong academic achievements and contributions to the Kennedy Waterfowl and Wetland Conservation Center as an up-and-coming specialist in **Carolina Bay ecosystems**.

RENE BROWN
M.S. Student

Rene Brown was selected for the prestigious **James C. Kennedy Graduate Research Fellowship**, receiving **$20,000** to support her graduate research in waterfowl and wetland ecology. This fellowship recognizes her exceptional research potential, academic excellence, and commitment to advancing conservation science.

OLUWATOBI OLANIYI
Ph.D. Student

Oluwatobi Olaniyi earned an impressive array of research and travel awards this year. His accomplishments include the **Society of Wetland Scientists Graduate Research Grant ($1,000)**, the **CAFLS Interdisciplinary Award ($4,000)**, the **Creative Inquiry Research Award ($4,000)**, and the **Wade Stackhouse Fellowship ($7,500)**. He also received **Clemson Graduate Travel Grants for 2024 and 2025 ($750 each)** and was selected for the **C.A.R.E.** Fellowship through the Southeastern Association of Fish and Wildlife Agencies, which covered conference registration and travel. Collectively, these honors highlight his outstanding research contributions, interdisciplinary leadership, and commitment to advancing wetland conservation.

CHRISTOPHER PETTENGILL
Ph.D. Student

Christopher Pettengill received multiple competitive awards this year, including the **South Carolina Wildlife Federation Award ($500)**, the **Society of Wetland Scientists Award ($1,000)**, and the **South Carolina Mitigation Association Scholarship ($2,000)**. These recognitions reflect his academic excellence and his growing contributions to wetland science and wildlife conservation.

AKSHIT SUTHAR
Ph.D. Student

Akshit Suthar received numerous prestigious awards supporting his research, leadership, and professional development. These include the **James C. Kennedy Graduate Research Fellowship ($20,000)**, a **Clemson Forestry and Environmental Conservation Graduate Research Assistantship ($5,000)**, and research grants from the **Society of Wetland Scientists ($1,000)** and the **Slocum-Lunz Foundation ($1,500)**. He also earned several travel grants, including **Clemson Graduate Travel Grants (2024 and 2025)**, the **American Ornithological Society Travel Grant ($1,575)**, and **The Wildlife Society's Drone Working Group Grant ($350)**, along with a **$4,000 Creative Inquiry** award. Akshit was further recognized through his election as **Co-Chair of the American Ornithological Society Student Affairs Committee (2024–2026)** and his service on the **AOS Meeting Coordination Committee**, underscoring his national leadership in ornithology and wetland science.

ARUA YAYM DE CASTRO FERREIRA
M.S. Student

Arua Yaym de Castro Ferreira earned the highly competitive **James C. Kennedy Center Fellowship for 2025–26 ($24,000)**, recognizing exceptional promise in wetlands and waterfowl research. He also received a **$1,000 scholarship** from **The Wildlife Society's Wetlands Working Group,** and a **$1,000 Clemson Graduate Travel Grant for Spring 2025**, supporting his participation in national conferences and continued professional development.

2025 Advisory COUNCIL

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CLEMSON® UNIVERSITY

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2025 James C. Kennedy Waterfowl & Wetlands Center

STAFF

CRYSTAL ANDERSON

Wildlife Biologist III
Ph.D. Student

Crystal Anderson is a staff biologist at the James C. Kennedy Waterfowl and Wetlands Conservation Center, a Certified Wildlife Biologist® through The Wildlife Society (2024), and a Ph.D. student in Wildlife Biology at Clemson University. She holds a bachelor's degree in wildlife biology and a master's degree in forest resource management, where her research focused on how recreational use influences the spread of invasive species in the Clemson Experimental Forest.

Crystal's passion for nature began early, but her time living in the Pacific Northwest was transformative. There, she witnessed firsthand how human activity and environmental policy shape not only ecosystems but also the well-being of local communities. This experience deepened her commitment to pursuing solutions that balance ecological integrity with human needs.

At the Kennedy Center, Crystal leads initiatives that blend ecological research with community engagement. She collaborates with Gullah Geechee communities in rural South Carolina to promote pollinator awareness and develop community gardens that support food security and agricultural resilience. Her doctoral research explores pollinator diversity in wetland-associated ecotones and models potential range shifts under future climatic scenarios. Her long-term goal is to continue working at the nexus of human dimensions, conservation, and wildlife management.

Outside of work, Crystal enjoys spending time with her husband and children exploring local parks, relaxing at the beach, playing putt-putt, and sampling new cuisines. A passionate karaoke enthusiast and music lover, she shares her home with three dogs, five rescue cats, a variety of fish, and a ball python named Oakley.

Keegan Foster began working as a wildlife biologist at the James C. Kennedy Waterfowl and Wetlands Conservation Center in September 2024. He graduated from the University of Rhode Island in the spring of 2023 with a bachelor's degree in wildlife conservation and biology.

Since graduating, Keegan's research interests have largely focused on avian movements, diet, and habitat selection.

One of his most formative experiences occurred in his ornithology course at university. While he was already passionate about birds at this time, he was not aware of one of the most important avian research techniques, bird banding. After experiencing passerine and owl banding firsthand, he knew he wanted to study birds in the future. Ever since, he has continued to build up his field skills with a wide variety of avian species so that one day, he may conduct his own research on lesser-known, cryptic birds.

Being a staff biologist, Keegan's main responsibility is to assist graduate students with their field research. Because of this, he dabbles in a broad array of projects at the Kennedy Center. One day he may be banding ducks, whereas the next he may be performing anuran surveys.

In addition to helping students with their research, Keegan has been tasked with conducting his own. His ongoing project revolves around *Nymphaea mexicana*, otherwise known as banana water lily, and its use in waterfowl management.

KEEGAN FOSTER

Wildlife Biologist I

CAMERON HOLLANDER

Field Technician

Cameron Hollander was born in Boston, Massachusetts and raised in New Jersey before recently moving down to Charleston to pursue his passion for wildlife biology. Cam's love for nature started at a young age, influenced by the likes of Steve Irwin, his dream is to one day work with saltwater crocodiles and the various reptiles he was introduced to while watching the crocodile hunter. It was while receiving his bachelor's degree in Wildlife and Fisheries Science from The Pennsylvania State University that Cameron first started field work and found his foothold into the world of conservation research. While working as a field tech for the university between 2023-2024, he engaged in various research projects and picked up skills that would culminate in the desire to continue working in field biology. Some highlights include radio telemetry tracking of box and wood turtles, capture-mark-recapture surveys and swabbing of eastern red-spotted newts for chytrid fungus, and habitat quality analysis through the assessment of foliage and its impact on thermal ecology. Since this Cameron has spent time taking a more hands-on approach to wildlife conservation and education by interning at the Avian Conservation Center's medical clinic and education departments. It was during this experience that he was able to observe the direct implications of the rise in human-wildlife conflicts and how education plays a role in preventing unnecessary wildlife mortalities.

Cam is now working at the James C. Kennedy Waterfowl and Wetland Center as a field technician as it provides an opportunity to combine past experiences and to better inform public education through the collection and analysis of field data.

In his free time Cameron enjoys being out in nature, learning about music production, and education through Clemson's Wildlife and Fisheries Resource Management masters program this upcoming spring watching his Boston sports teams. He is also currently looking forward to continuing his education through Clemson's Wildlife and Fisheries Resource Management masters program this upcoming spring.

Andrew Hopkins is a postdoctoral fellow at the Kennedy Center working with Dr. James T. Anderon. His primary interests lie in the areas of ecotoxicology, disease ecology, and how species respond to the combined effects of these two unique stressors. His current work focuses on developing techniques and methodologies to test for the detection of avian influenza in wetlands as well as the development of models to predict spread. Additionally, he is also interested in developing tracking and screening programs for the spread of other major pathogens of concern for avian species as well as the detection of rare bird species.

Before joining the Kennedy Center and Clemson University, Andrew completed a postdoctoral position at Purdue University Veterinary School, where he worked in the Department of Comparative Pathobiology. During this time, he was co-advised by Drs. Wendy Beauvais and Christopher Rice. His work focused on the perceptions and knowledge of backyard and small-scale poultry owners towards biosecurity and avian influenza. He also worked on projects studying the usage of antibiotics and antibiotic resistance in canines and amoeba. Before this, he received his Ph.D. from Purdue University in the Department of Forestry and Natural Resources.

His research focused on the impacts and spread of agricultural fungicides in wetland environments with a focus on amphibian populations. His work is some of the first to investigate the impacts of this class of pesticides on natural non-model organisms and demonstrated the threats that these contaminants can pose. He received his master's from Western Michigan University, where he studied the distribution of herpetofauna in the interdunal wetlands of Lake Michigan. He has also worked as an environmental chemist focusing on the detection and extraction of semi-volatile organic compounds in urban systems.

Andrew moved to South Carolina from Indiana in August of 2024. He is looking forward to getting a chance to work with new pathogens and species as well as continuing to develop his professional niche. In his free time, Andrew enjoys trying out new recipes to bake, reading, painting, and playing games.

ANDREW P. HOPKINS

Ph.D. Postdoctoral Fellow

MARGARET JENSEN
Waterfowl Biologist

Margaret grew up in the temperate and sub-boreal forests of New Hampshire, running up and down mountains and eagerly exploring every possible landscape. Since getting their bachelor's in Conservation Biology at St. Lawrence University in northern New York in 2020, Margaret has been deepening their love for birds through fieldwork all over the world. They've monitored nesting Common Loons and Rusty Blackbirds in northern New Hampshire. They've maintained habitat for native waterbirds in Hawaii's wetlands, and studied fruit dispersal by nonnative birds in its upland forests. They spent a winter on Kuaihelani (Midway Atoll) banding albatross, surveying for Laysan Ducks and various shorebirds, and removing invasive plants. Off the coast of Maine, they supervised a team monitoring tern growth and productivity for two summers. They nest-searched Superb Fairy-wrens in Australia and Great Grey and Spotted Owls in California. Margaret has also worked at passerine banding stations in Ontario, Alaska, and Pennsylvania.

At the Kennedy Center, Margaret works as a waterfowl biologist investigating the behavior and genetics of game-farm Mallards in South Carolina, as well as how they affect wild Mallard populations. They're eager to get to know the ducks, people, and landscapes of South Carolina, and to add a new species and location to their list of experiences.

When they're not staring at or waiting for birds, Margaret can be found making art, telling stories, playing music, wandering at various speeds through the woods, or in some form of boat.

Brit Nahorney grew up in Oregon and has assisted with avian and small mammal research throughout the United States. She's previously conducted fieldwork for the Hawaii VINE Project on Oahu, as a least bell's vireo and MAPS station technician for USGS, and surveyed breeding marbled murrelet for Oregon State University. She has also trapped and tracked New England cottontail in New York, assisted with clapper rail research, and was a crew lead for the Saltmarsh Habitat and Avian Research Program in Maine which included searching for nelson's sparrow and savannah sparrow nests, banding birds, and collecting avian blood samples.

Brit holds a bachelor's degree in Environmental Biology and a master's degree in Biology. During her graduate research, she studied the phenology of cerulean warbler nest stages and caterpillar abundance in Indiana along with the diet and gut microbiome of cerulean warbler. She is joining the James C. Kennedy Waterfowl & Wetlands Conservation Center after working as an environmental reviewer at New Hampshire Fish and Game where she provided conservation measures for developmental impacts to threatened and endangered species in the state, before the review program ended. She's excited to explore South Carolina and to add as many southern bird species to her life list as possible.

In her free time, Brit enjoys hiking, photographing arthropods, cheering on her favorite hockey team, and watching birds.

BRITTANY NOHORNEY
Wildlife Biologist I

BRANDON ROSS
Wildlife Biologist I

Brandon Ross is a Wildlife Biologist at the James C. Kennedy Waterfowl and Wetlands Conservation Center. He grew up outside of Philadelphia and graduated from the University of Connecticut in 2021 with a degree in Natural Resources and Ecology/Evolutionary Biology. Brandon then left the Northeast, heading south to work on the Georgia Coast as a naturalist, assisting graduate students with their fieldwork and investigating reptile communities' responses to prescribed fire. After spending several years in Georgia, he moved to New Jersey to work as a research assistant studying the spatial ecology of diamondback terrapins and monitoring saltmarsh restoration projects at The Wetlands Institute.

Brandon now works at the James C. Kennedy Waterfowl and Wetland Center as a biologist, working to establish pre-restoration baselines for a property near Brunswick, Georgia. This project aims to quantify the efficacy of restoration efforts and inform future management decisions regarding habitat restoration in coastal wetland systems.

In his free time, Brandon enjoys spending his time outdoors hiking, birding, snowboarding, and fly-fishing, while sharing his passion for the natural world with those around him.

PUBLICATIONS
ORAL & POSTER
PRESENTATIONS

PUBLICATIONS *(n=17)*

Anderson, J. T. 2024. Summer ducks. The Waterbird Society Newsletter 1.

Anderson, C., A. P. Hopkins, and J. T. Anderson. 2025. Assessing the impact of solar farms on waterbirds: A literature review of ecological interactions and habitat alterations. Conservation 5(1):4. https://doi.org/10.3390/conservation5010004

Anderson, J. T., A. P. Hopkins, C. Anderson, M. Boucher, R. Brown, A. de Castro, S. De Silva, R. M. Greco, Jr., J. E. McCall, O. E. Olaniyi, C. Pettengill, A. R. Suthar, and C. L. Von Haugg. 2025. Wildlife of tidal forested wetlands in the southeastern Atlantic United States. Estuarine, Coastal, and Shelf Science 325:109500 https://doi.org/10.1016/j.ecss.2025.109500

Becker, D. N., D. J. Brown, J. A. Hubbart, and J. T. Anderson. 2025. Environmental factors influencing bioaccumulation of xenobiotic metals in freshwater turtles. Environmental Pollutants and Bioavailability 37(1), 2474007. https://doi.org/10.1080/26395940.2025.2474007

Binger, S., M. Stokoski, and C. F. Narr. 2025. Phosphorus enrichment increases the prevalence of a microsporidian parasite in experimental Daphnia populations. Limnology and Oceanography e70108. https://doi.org/10.1002/lno.70108

Boucher, M. N., J. M. Stillwell, M. Tellez, S. M. Boylan, T. R. Rainwater, S. L. Whitmire, and J. T. Anderson. 2025. Pansteatitis in wild American alligators (*Alligator mississippiensis*). Journal of Wildlife Diseases 61(3):797-801. https://doi.org/10.7589/JWD-D-24-00190

Brown, D. J., A. L. Gulette, J. M. Baker, J. Hatton, and J. T. Anderson. 2024. Habitat quality of restored wetlands in agricultural systems for freshwater turtles. Herpetological Conservation and Biology 19(2):189-207. https://www.herpconbio.org/Volume_19/Issue_2/Brown_etal_2024.pdf

De La Cruz, J. L., S. E. Rauch, and J. T. Anderson. 2025. Home range size and resource use of male eastern wild turkeys in West Virginia. Journal of the Southeastern Fish and Wildlife Agencies 12:77-85.

Miller, E. M., R. M. Kaminski, B. A. Bauer, G. K. Yarrow, K. Barrett, and J. T. Anderson. 2024. Evaluating deterrents to reduce depredation of wood duck eggs in nest boxes. Wildlife Society Bulletin 48(3)e1544:1-12. http://doi.org/10.1002/wsb.1544

Molina, J. T., C. C. Arantes, B. A. Murry, W. Veselka IV, and J. T. Anderson. 2024. Integrating aquatic species, assemblage, and habitat climate change vulnerabilities into a watershed-scale decision support framework. Ecological Indicators 166:112523. https://doi.org/10.1016/j.ecolind.2024.112523

Pandey, M., A. Mishra, S. L. Swamy, J. T. Anderson, T. K. Thakur. 2025. Machine learning-based monitoring of land cover and reclamation plantations on coal-mined landscape using Sentinel 2 data. Environmental and Sustainability Indicators 25:100585. https://doi.org/10.1016/j.indic.2025.100585

Pradhan, A., A. Sao, T. K. Thakur, J. T. Anderson, G. Chandel, A. Kumar, V. Paramesh, D. Jinger, and R. Kumar. 2025. Wetlands as climate-sensitive hotspots: evaluating greenhouse gas emissions in southern Chhattisgarh. *Water* 17(10):1553. https://doi.org/10.3390/w17101553

Shurba, J. A., K. J. Whitehead, H. L. Schley, B. A. Bauer, R. K. Barrett, G. D. Yarrow, and J. T. Anderson. 2024. Does nesting material affect wood duck nest box selection, reproduction, and eggshell bacteria? Journal of Wildlife Diseases 60(3):615-620. https://doi.org 10.7589/JWD-D-23-00013

Suthar, A. R., A. R. Biggs, and J. T. Anderson. 2025. A decadal change in shorebird populations in response to temperature, wind, and precipitation at Hilton Head Island, South Carolina, USA. Birds 6(1), 14. https://doi.org/10.3390/birds6010014

Suthar, A. R., O. E. Olaniyi, A. Pierce, and J. T. Anderson. 2025. New research will help conserve South Carolina's historic coastal impoundments. Ducks Unlimited Magazine 89(1):77.

Suthar, A. R., and J. T. Anderson. 2024. Landscape legacy: Waterbird conservation and historic rice fields of Coastal South Carolina, USA. Jalaplavit 14(1&2):15-30.

Von Haugg, C., R. F. Baldwin, B. A. Bauer, A. S. Bridges, E. P. Wiggers, D. L. Hagan, and J. T. Anderson. 2025. Occurrence of natural tree cavities suitable for nesting wood ducks across South Carolina forest types. Journal of Wildlife Management 89:e70059. https://doi.org/10.1002/jwmg.70059

Oral & Poster PRESENTATIONS *(n=37)*

Aldridge, D., S. Whitmire, T. Rainwater, M. Boucher, and J. T. Anderson. 2025. *Contaminant Distribution in South Carolina Coastal Wetlands.* 2025 Annual Council meeting, James C. Kennedy Waterfowl and Wetlands Conservation Center, Georgetown, South Carolina. (Oral)

Anderson, C.M., J. Anderson, J. Hallo, J. Hartshorn, and D. White. 2025. *Roots of Resilience: Empowering Rural African American Communities Through Pollinator Conservation and Community Gardens.* International Gullah Geechee and African Diaspora Conference, Conway, South Carolina. (Oral)

Anderson, C.M., J. Hallo, J. Hartshorn, & D. White, and J. T. Anderson. 2025. *Pollinators and People: Linking Conservation and Community Resilience in Coastal Wetlands.* Behind the Gate, Baruch Institute of Coastal Ecology and Forest Science, Clemson University, Georgetown, South Carolina. (Poster)

Anderson, C.M., J. Hallo, J. Hartshorn, & D. White, and J. T. Anderson. 2025. *Integrating Community Engagement, Field Surveys, and GIS to Assess Pollinator Communities and Future Risks in Coastal Wetlands.* James C. Kennedy Waterfowl and Wetlands Conservation Center Advisory Council Meeting, Georgetown, South Carolina. (Hosting/Oral).

Binger, S. and J.T. Anderson. 2025. *Carolina Bays in South Carolina: Inventory, Types, and Biological Communities.* South Carolina Wildlife Federation Wildlife & Habitat Team Meeting. Irmo, South Carolina. (Invited)

Binger, S. and J.T. Anderson. 2025. *Developing Anuran Indices of Biotic Integrity for Carolina Bays Across 13 South Carolina Counties.* Southeastern Partners in Amphibian and Reptile Conservation Annual Meeting 2025. Guntersville, Alabama. (Poster)

Binger, S. and J.T. Anderson. 2025. *Fauna and Flora as Indicators of Habitat Quality in Isolated Carolina Bay Wetlands.* Society of Wetland Scientists Annual Meeting 2025. Providence, Rhode Island. (Poster)

Binger, S. and J.T. Anderson. 2025. *Flora and Fauna as Indicators of Habitat Quality in Carolina Bay Wetlands.* 2025 Annual Council meeting, James C. Kennedy Waterfowl and Wetlands Conservation Center, Georgetown, South Carolina. (Oral)

Bledsoe, B. T., Kern, H. M., Myers, A. H., Geelhoed, C. J., O'Donnell, J. T., Massey, T. M., McKellar, R., Spalt, J., Anderson, C. M., Suthar, A. R., and Anderson, J. T. (2025). *Waterfowl populations and human dimensions: Hunter satisfaction survey* [Poster presentation]. 20th Annual Friends of the Clemson Institute (FoCI) and The Clemson Student Research Forum (CSRF), Clemson University, Clemson, SC, United States.

Brown, R., J.T. Anderson, A.E. Scaroni, T.L. O'Halloran. 2025. *Decomposition Rates of Black Needlegrass (Juncus romerianus and Saltmarsh Cordgrass (Sporobolus alterniflorus) Leaf Litter in an Impounded Saltmarsh.* "Behind the Gate" at Belle W. Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA (Poster). Agencies, Charleston, West Virginia (Poster).

Brown, R. C, Pettengill, J.T. Anderson, A.E. Scaroni, T.L. O'Halloran, T. Farmer, 2024. *Will oysters assist biodiversity and ecosystem service recovery at Little Edisto Satmarsh? Inclusion of oysters in resestoration scheme for salt marsh habitat.* The International Conference on Shellfish restoration ICSR 2024 , Jekyll Island, Georgia. (Poster).

Caroll, T. D., Whitmire, S., de Castro, A. Y., Anderson, C., Foster, K., and Anderson, J. T. 2025. *Assessing the Presence and Abundance of Microplastics in the Gizzard of Green-winged Teal (Anas carolinensis) in a Historic Antebellum Rice Field in South Carolina.* 2025 Annual Council meeting, Baruch Institute for Marine and Coastal Sciences, Georgetown, South Carolina. (Poster)

de Castro, A. Y., Jodice, P. G., Rock, K. D., White, D. L. and Anderson, J. T. 2025. *Assessing the Presence and Concentration of Microplastics in the Gizzard of Green-winged Teal (Anas carolinensis) in Historic Antebellum Rice Fields in South Carolina.* 2025 Annual Council meeting, James C. Kennedy Waterfowl and Wetlands Conservation Center, Georgetown, South Carolina. (Oral)

de Castro, A. Y., Jodice, P. G., Rock, K. D., White, D. L. and Anderson, J. T. 2025. *Assessing the Presence and Concentration of Microplastics in the Gizzard of Green-winged Teal (Anas carolinensis) in Historic Antebellum Rice Fields in South Carolina.* Wetlands Working Group Spring Meeting, webinar, virtual. (Oral)

de Castro, A. Y., Baker, C., Boucher, M., and Anderson, J. T. 2024. *Diet and Ingested Microplastics in American Alligators (Alligator mississippiensis) in South Carolina.* 78th Annual Southeastern Association of Fish and Wildlife Agencies Conference (SEAFWA), Augusta, GA, United States. (Poster)

de Castro, A. Y., Jodice, P. G., Rock, K. D., White, D. L. and Anderson, J. T. 2024. *Mercury Accumulation in Wetland-dependent Birds within the Bento Gomes River Watershed in the Northern Pantanal, Brazil.* CAFLS Graduate Student Symposium, Clemson, SC. (Poster)

Duncan, Maiya and J.T. Anderson. 2025. *Genetic and Behavioral Divergence: A Comparative Study of Hybrid and Wild Mallards (Anas platyrhynchos) in Coastal South Carolina, USA.* Kennedy Center Advisory Board meeting held at Belle W. Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA (Oral)

Kern, H. M., Myers, A. H., Geelhoed, C. J., O'Donnell, J. T., Bledsoe, B. T., Massey, T. M., McKellar, R., Spalt, J., Suthar, A. R., Anderson, C. M., and Anderson, J. T. (2025). *Evaluating waterfowl detection probability using thermal and color drone imagery from antebellum rice fields of coastal South Carolina, USA* [Poster presentation]. 20th Annual Focus on Creative Inquiry (FoCI) and The Clemson Student Research Forum (CSRF), Clemson University, Clemson, SC, United States.

Massey, T., C.M. Anderson, and J.T. Anderson. 2025. *Assessing Pollinator Roles in Coastal Wetland Ecotones and Public Pollinator Perception to Inform Conservation and Education.* Behind the Gate, Baruch Institute of Coastal Ecology and Forest Science, Clemson University, Georgetown, South Carolina. (Poster)

Olaniyi, O.E., Famoyegun, O., Anozie, E.L., Farmer, T.M. and Anderson, J.T. 2025. *Omo Forest Wetlands (Nigeria): Modeling Habitat Quality and Degradation.* Graduate Research Seminar, College of Agriculture, Forestry and Life Sciences, Clemson University, USA (Poster).

Olaniyi, O.E., T.M. Farmer, and J.T. Anderson. 2025. *Climate change threatens historic rice fields: A Hierarchical Bayesian model approach to predicting coastal wetland loss.* Society of Wetland Scientists (SWS) 2025 Annual Meeting in Providence, Rhode Island, USA (Oral).

Olaniyi, O.E., T.M. Farmer, T.H. Folk, D.L. White, C.M. Anderson, and J.T. Anderson. 2025. *Adaptive management advances in South Carolina's historic rice fields bolster waterfowl conservation: Stakeholder survey findings.* Kennedy Center Advisory Board meeting at Belle W. Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA (Oral).

Olaniyi, O.E., T.M. Farmer, D.L. White, T.H. Folk, P.O. Akinwumi, and J.T. Anderson. 2025. *Geospatial Analysis of Management Impacts on Ecosystem Health of Selected Private Historic Rice Plantations in Georgetown County, USA.* "Behind the Gate" at Belle W. Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA (Poster).

Olaniyi, O. E., Soliu, T. O., Akindele, A. F. I., Farmer, T. M., Suthar, A. R., & Anderson, J. T. (2024). High wetland habitat quality amid emerging stressors: Insights from the wetlands of Oba Water Reservoir, Nigeria [Oral presentation]. British Ecological Society Meeting, Liverpool, United Kingdom.

Olaniyi, O.E., F.J. Ajayi, I.A. Adeyemo, J.T. Anderson, and T.M. Farmer. 2024. *Assessing habitat suitability for aqua tourism in wetlands: A Ekiti State, Nigeria*. Center for Diverse Leadership in Science (CDLS) Research and Outreach Symposium Summer 2024 at the CDLS, Institute of the Environment and Sustainability, University of California, Los Angeles, USA (Oral).

Olaniyi, O.E., T.M. Farmer, and J.T. Anderson. 2024. *Socio-ecological trade-offs: Balancing waterfowl conservation and community needs in Antebellum Rice Fields, South Carolina, USA*. Kennedy Center Advisory Board meeting held at Belle W. Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA (Oral).

Olaniyi, O.E., T.M. Farmer, and J.T. Anderson. 2024. *Ecohydrological Shifts in Antebellum Rice Fields: Implications of Climate Change in Georgetown County, USA*. Graduate Research Seminar, College of Agriculture, Forestry and Life Sciences, Clemson University, USA (Poster).

Suthar, A. R., Pierce, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2025). *Enhancing waterfowl surveys with color and thermal drone imagery in South Carolina's antebellum rice fields.* Northern Bobwhite Grassland Initiative Technical Committee and Eastern Partners in Flight Joint Meeting, Clemson University, SC, USA. (Poster)

Suthar, A. R., Pierce, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2025). *Integrating ecology and emerging technologies to monitor waterbirds in antebellum rice fields.* Behind the Gate Event, Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA. (Talk)

Suthar, A. R., Biggs, A. R., and Anderson, J. T. (2025). *A decadal change in shorebird populations in response to temperature, wind, and precipitation at Hilton Head Island, South Carolina, USA.* Behind the Gate Event, Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, USA. (Poster)

Suthar, A. R., Pierce, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2025). *Drone-based assessment of waterbird habitat uses in antebellum rice fields of coastal South Carolina.* James C. Kennedy Waterfowl and Wetlands Conservation Center Annual Advisory Meeting, Georgetown, SC, USA. (Talk)

Suthar, A. R., Pierce, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2025). *Understanding waterbird habitat relations with antebellum rice fields using drones.* Friends of Nemours Event, Nemours Wildlife Foundation, SC, USA. (Talk) abundance of natural cavities suitable for nesting wood ducks. South Carolina Chapter of The Wildlife Society, Columbia, South Carolina.

Suthar, A. R., McAlister, M. A., Bauer, B. A., Folk, T. H., Dozier, J., Elmore, J. A., Buchholtz, E. K., Pierce, A. R., and Anderson, J. T. (2024). *Factors affecting bird use of antebellum rice fields of coastal South Carolina: A case study from Yawkey Wildlife Center.* 78th Annual Southeastern Association of Fish and Wildlife Agencies Conference (SEAFWA), Augusta, GA, USA. (Invited Talk)

Suthar, A. R., McAlister, M. A., Bauer, B. A., Folk, T. H., Dozier, J., Elmore, J. A., Buchholtz, E. K., Pierce, A. R., and Anderson, J. T. (2024). *Are drones the future of waterbird surveys? Comparing drone and ground-based survey methods to count waterbirds in coastal South Carolina*. The Wildlife Society 31st Annual Conference, Baltimore, MD, USA. (Talk)

Suthar, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2024). *Understanding waterbird habitat relations with antebellum rice fields using drones.* Waterfowl Management Workshop, Nemours Wildlife Foundation, Yemassee, SC, USA. (Invited Talk)

Suthar, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2024). *Drone-based aerial surveys: Understanding waterbird habitat relations in antebellum rice fields of coastal South Carolina.* USFWS Waterfowl Course, Nemours Wildlife Foundation, Yemassee, SC, USA. (Invited Talk)

Suthar, A. R., Pierce, A. R., Elmore, J. A., Buchholtz, E. K., Folk, T. H., and Anderson, J. T. (2024). *Advancing waterbird conservation: A comparative study of drone and ground surveys in antebellum rice fields of coastal South Carolina.* CAFLS 3rd Graduate Research Symposium, Clemson University, SC, USA. (Talk)


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