James C. Kennedy
WATERFOWL & WETLANDS CENTER
CLEMSON UNIVERSITY

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JAMES C. KENNEDY WATERFOWL & WETLANDS CONSERVATION CENTER

2019

annual report

LEAD IN EDUCATION AND SCIENCE TOWARD CONSERVATION OF SOUTH ATLANTIC AND OTHER WETLAND ECOSYSTEMS

On our cover
Barbara Kennedy Harty and son, James Cox Harty,
after a successful duck hunt at Clarendon Plantation,
Beaufort, SC, November 2018

Design by Charlene P. Mayfield
Clemson University, PSA Publications


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FROM THE DIRECTOR

Phase 1 completed! What was Phase 1? Phase 1 was the first three years (2015-2018) of Clemson University's James C. Kennedy Waterfowl and Wetlands Conservation Center under my privileged directorship.

Each of the previous annual reports highlighted our accomplishments in teaching, research, and outreach—the crucial land-grant university missions of Clemson University and the Kennedy Center. Our previous reports can be accessed from our web page in the lower left column at: https://www.clemson.edu/cafls/departments/kennedycenter/ This report will provide a similar review of this year's actions but also address our 'compass points' going forward during Phase 2.

Teaching

Ph.D. candidate and Kennedy Center Fellow, Lauren Hernandez-Rubio Senn, and I continued teaching the online undergraduate and graduate level course in Waterfowl Ecology and Management (https://www.clemson.edu/online/programs/wildlife-fisheries-biology.html). The online version of the course was offered initially in fall semester 2017 and enrolled 25 students. In fall 2018, we more than doubled enrollment with 23 graduate and 36 undergraduate students from across the country. Graduate students in the course are enrolled in Clemson's online Master's degree program in Wildlife and Fisheries Biology. Please read Lauren's article herein for details about the online waterfowl course and ways she is evaluating its effectiveness as part of her dissertation research. To our knowledge, ours is the only online course in Waterfowl Ecology and Management worldwide. Many of the students enrolled in the course are working professionals who cannot matriculate to campus for face-to-face courses. Indeed, our department is fulfilling an important educational and career-advancing "niche" for these off-campus students and providing them with a specialty course in waterfowl ecology and management at a time when such courses are becoming scarce at North America universities. For this perspective on rarity, you may like to review, "Who will mind the marsh?," a feature article in our 2018 Kennedy Center annual report, originally published by Delta Waterfowl Foundation (https://www.clemson.edu/cafls/departments/kennedycenter/pdf/kennedy-report-2018.pdf).

Research

Gillie Croft and Beau Bauer, both Nemours Wildlife Foundation (NWF) and Kennedy Center graduate students, completed their respective M.S. degrees and graduated with high honors in December 2018. Please read Beau's and Gillie's thesis abstracts herein. Currently, both Beau and Gillie are wildlife biologists employed by NWF in Yemassee, South Carolina.

We are expanding Gillie's wood duck study to investigate homing and recruitment rates of box-nesting female wood ducks in southeastern United States. Ours is a joint study among the NWF, the Kennedy Center, the South Carolina Department of Natural Resources (SCDNR), the Delaware Division of Fish and Wildlife, Mississippi State University, University of Delaware, and other partnering states that will join in 2020. Currently, we are monitoring about 160 nest structures in a pilot study in south-central South Carolina on Lake Moultrie to assess our wood duck marking techniques, habitat measurements, and other technical objectives (http://www.dnr.sc.gov/lakes/moultrie/description.html). No such study ever has been conducted over the Southeast region and flyways to estimate recruitment rates of box-nesting female wood ducks and determine cost-effectiveness of this century-old management technique. Our Team Wood Duck technicians penned a story about the pilot study in the research section of this report. We invite your reading pleasure of it.

Nick Masto, a current Kennedy Center Master's Student Fellow, has completed his field research on evaluation of aerial line-transect sampling to estimate abundance and distribution of waterfowl and other waterbirds and habitat associations of these birds in South Carolina. South Carolina is the only state in the Atlantic Flyway currently conducting fall and winter aerial transect surveys of waterfowl and waterbirds inland of the Atlantic Ocean. Please read Nick's research abstract in this report. Nick will begin a Ph.D. program this fall, studying wintering mallards in the Lower Mississippi Valley under Dr. Bradley Cohen at Tennessee Tech University.

Outreach

Since inception in 2015, the Kennedy Center has collaborated with partners to convene the following four waterfowl habitat and hunting management workshops at: 1) Clemson's Baruch Institute of Coastal Ecology and Forest Science and Kennedy Center in the Santee Delta-Winyah Bay Region (October 2015); 2) Greater Pee Dee Basin at The Catfish Farm, hosted by Joseph Richardson, Richardson Construction, Inc. (February 2018); 3) ACE Basin, hosted by the NWF (October 2018); and 4) Santee Coastal Reserve, SCDNR (February 2019). Between 50-80 biologists, managers, students, and conservation enthusiasts attended each of these workshops. Additionally, we are planning a fall 2019 waterfowl hunting workshop, targeting Clemson University students who presently are non-hunters but keen to try this form of recreational conservation. We welcome non-traditional hunters to "flock" with us and help recruit, retain, and reactivate hunters in waterfowling. We especially thank Barbara Kennedy Harty for accompanying and mentoring her son, James, on duck hunts, such as the one pictured on the front cover of this report at Clarendon Plantation near Beaufort, South Carolina.

We continue to visit public and private waterfowl areas to provide management information, as well as participate in workshops and symposium at state, regional, and national venues. Additionally, we were guests of Mr. and Mrs. Paul Bonderson at their California Bird Haven Ranch in December 2018. There, faculty and graduate students of endowed university waterfowl and wetlands programs from across the country gathered to share needs for future waterfowl and wetlands research collaboration and networking across the flyways. We also plan to co-host with the NWF and other partners waterfowl and wetlands special sessions at the 2019 8th North American Duck Symposium (Winnipeg, Manitoba, August 2019, http://www.northamericanducksymposium.org/) and the Southeastern Association of Fish and Wildlife Agencies Annual Conference (Hilton Head, South Carolina, http://www.seafwa.org/conference/).

Future "Flights" by Kennedy Center and Partners - Phase 2

We were invited by the NWF to partner in convening a workshop in February 2018 to identify priority research needs for the southern extent of the Atlantic Flyway and southeastern United States. Over 30 waterfowl and wetlands biologists from the Atlantic and Mississippi Flyways participated in the workshop and helped craft a document detailing the group's consensus on research priorities. This document is available from NWF (http://www.nemourswildlifefoundation.org/).

We also are developing proposals to quantify ecosystem services and economic values of managed impounded and non-managed historic rice fields in South Carolina. A NWF and Clemson University study estimates existence of about 250,000 acres of historic former rice fields, originally constructed by enslaved people beginning in the late 1600s. These former rice fields, many of which now are actively managed for waterfowl and other wetland wildlife, generate ecosystem services, including potentially reducing green-house gas emissions and effects of hurricanes, abating sea-level rise, reserving water and improving its quality, and providing recreational opportunities and revenues from hunting, fishing, crabbing, and shrimping. Indeed, these historic rice fields are another ecological and economic "wonder of the world" that deserve perpetual conservation from sea-level rise, human development, and other perturbations. However, their survival depends likely on broadly quantifying their economic and human values relative to carbon sequestration and other emerging conservation markets and initiatives. Fortunately, the Clemson University Baruch Institute has scientists and economists on site who have the skills to conduct this comprehensive study.

We believe that waterfowl will be sustained on the "wings" of scientific evidence documenting the diverse "goods and services" provided to humans and nature by wetlands and other natural ecosystems.

Acknowledgments

We are indebted to our partners and sponsors, the logos of which are presented below. Without their counsel and support we would not be as effective as we've been during Phase 1. We also recognize and sincerely thank our fellow organization and partner, the NWF, and its staff and board members.

Dr. Rick Kaminski, Beaux, and Rick's grandson, Tanner Mayberry (Old Rivers Club, Crowder, Mississippi, December 2018).

Mr. Kennedy—I trust you are reading these genuinely expressed words. Thank you for believing in the vision and necessity of endowing university-based waterfowl and wetlands programs at Clemson University and other sister universities. Clearly, you believe that we can provide the educational environments to produce the leaders "who will mind the marsh" during the 21st century and thereafter. Indeed, science and conservation do not occur without people. Thus, we pledge to discover, educate, communicate, and produce the leaders for waterfowl and wetlands science and conservation, consistent with your vision and intent for this and other endowed Kennedy programs of excellence.

Sincerely and gratefully,

Richard M. Kaminski

Director,
James C. Kennedy Center for Waterfowl and Wetlands Conservation

Thank you to our sponsors, cooperators, and friends:

James C. Kennedy

Mr. Tom Yawkey
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DELTA WATERFOWL

U.S. Fish & Wildlife Service

Atlantic Coast Joint Venture

South Carolina Waterfowl Association

TEACHING

ADVANCING WATERFOWL ECOLOGY AND MANAGEMENT: ASSESSMENTS OF DISTANCE EDUCATION, PROFESSIONALS' CREDENTIALS, AND GRADUATE STUDENT PUBLICATION PERFORMANCE

Lauren Senn
James C. Kennedy Waterfowl and Wetlands Conservation Center Ph.D. Fellow and Candidate
Clemson University

To our knowledge, only Clemson University currently offers a distance-education (online) course in Waterfowl Ecology and Management available to undergraduates and graduate students. Such a course is needed especially by those unable to matriculate to a campus where this type of course is offered. As part of my dissertation research, Dr. Rick Kaminski and I have converted his Waterfowl Ecology and Management course from traditional face-to-face lecture and laboratory to online presentation, and I am evaluating the transition and students' learning experiences and perceptions of the new online course.

The course has been offered in fall semesters since 2017, as an elective in Clemson University's online Master's degree in Wildlife and Fisheries Biology and for upper level undergraduates (http://www.clemson.edu/online/programs/wildlife-fisheries-biology.html). The conversion process involved video recording lecture material, using online software to transcribe the audio of each lecture, pairing transcribed video and audio with corresponding lecture slides, and re-recording audio to match videoed lectures. We wrote a script for hundreds of slides, enabling students to view and read text on slides after listening to scripts narrated by me. These tasks consumed months of work; however, the course is now archived, and updating and revision will be manageable annual tasks.

The course is split into nine modules: History of Waterfowl Conservation, Waterfowl Morphology and Identification, Habitat Use and Selection, Evolutionary Ecology Related to Waterfowl, Annual-Cycle Ecology and Management (Fall/Winter, Vernal [Spring] Migration, Reproduction, Post-breeding/Molting), Adaptive Harvest Management (by Dr. Beth Ross, USGS Cooperative Fish and Wildlife Research Unit, Clemson University), and Waterfowl Diseases. Each module also includes readings on current research and issues related to waterfowl ecology and conservation, class discussions, and quizzes/exams. Students are evaluated via module quizzes, a group oral presentation, a waterfowl identification exam, and midterm and final exams. To earn graduate credit for taking the course, graduate students propose a research project or special topic that is approved by Dr. Kaminski. They submit their proposal and final document to him writ-

ten in the style and format of an article for The Journal of Wildlife Management. Some students actually conduct the research as part of their online Master's degree special project through Clemson University. We also are exploring ways to provide online videoed field trips to important waterfowl and wetlands conservation areas across North America by collaborating with colleagues at other institutions and organizations.

The course will be assessed each semester by surveys returned by enrolled students. This evaluation includes three surveys given pre-, mid-, and post-course completion, and a pre- and post-course knowledge assessment test. A trial survey was given to students in the initial course offering in 2017, and the final Clemson Institutional Review Board approved surveys and assessments were given in the Fall 2018 course. Surveys ask basic demographics (undergrad/grad student), ask students to rate components of the course in terms of their effectiveness in helping them learn, compare their learning experiences from an in-person course (quality/quantity of learning, interaction with peers, interaction with instructors), and rate their experience with various wildlife technical skills and outdoor recreational activities. Surveys are administered via Qualtrics, with surveys set to only collect anonymous responses.

The initial Fall 2017 offering of Waterfowl Ecology and Management had an enrollment of 25 students (11 undergraduate and 14 graduate students). All students received grades of A, B, or C. The second offering of the course in Fall 2018 more than doubled enrollment with 59 students (36 undergraduate and 23 graduate students), earning with the same grade distribution. This increase in enrollment suggests expanded interest in the course and positive response or word-of-mouth promotion from past students. Trial surveys for Fall 2017 had a response rate of 60% (15/25). Fall 2018 response rates for the pre-, mid-, and post-course surveys were 59% (35/59), 98% (57/58), and 86% (50/58), respectively. Extra credit was offered as an incentive to increase response rate for both mid- and post-course surveys. To maintain anonymity of responses, students submitted their survey and then emailed a picture of their survey submission screen to me to earn extra credit in the form of a dropped quiz lowest grade.

Fall 2018 post-course survey results indicated that 98% of the students believed the course increased their knowledge and appreciation of waterfowl, and 94% would recommend the course to others. When compared to an in-person course, 46% of students indicated the course increased their quality and quantity of learning experience. This response suggests that the waterfowl online course increased both quality and quantity of learning for students when compared to in-person and other online courses. When asked if online courses in general increased their quality and quantity of learning experience, 30% responded with 'increased' or 'somewhat increased'. A paired t-test of students' pre- and post-knowledge assessment scores showed a significant increase in score from the start to the end of the course (pre-test $\bar{x}$ = 41.6% of 10 questions, post-test $\bar{x}$ = 66.6%; t_{54} = 9.97; $P < 0.0001$), supporting the inference that students gained substantial knowledge of waterfowl ecology and management from the course.

Survey analysis will continue in 2019 and subsequently. Results from 2017-2019 classes will provide data for my dissertation on students' perceptions of the new online course, how this course compares to in-person classes, and aid in the development of best practices for similar online wildlife courses through Clemson and other universities.

In addition to working on the course, I have collaborated with Drs. Kaminski, Shari Rodriguez (Clemson University), and Chris Williams (University of Delaware) on a survey to collect waterfowl professionals' perceptions of graduate students' scientific publishing performance, incentives and barriers to publishing, and students' perceived importance to publish. Surveys were

sent via Qualtrics to participants of the 6th and 7th North American Duck Symposium (NADS 6 and 7 [2013 and 2016, respectively]). A separate student survey was sent to those who indicated they were students at the time of NADS 7. Response rate for professionals was 42% (196/469) and 45% (44/98) for students. Data analysis for this study is underway, and I will draft a manuscript for publication and present the results at NADS 8 in Winnipeg, Manitoba, Canada, in August 2019.

Lastly, I will be collaborating with Drs. Rodriguez and Kaminski on a survey to be administered to attendees of NADS 8 in Winnipeg, Manitoba, Canada, August 2019. The survey will be designed to profile demographics and professional characteristics of attendees to help determine critical credentials and experiences that promote one becoming a waterfowl and wetlands professional.

Lauren Senn embracing Canada goose goslings during a spring 2018 field course to North Dakota and Manitoba, Canada, hosted by Delta Waterfowl Foundation.

FEATURE ARTICLE
FOLLOW THAT DUCK!

The following feature article is reprinted from *The Wildlife Professional* (December 2018) with permission from The Wildlife Society. The authors, Nick Masto and Gillie Croft, were M.S. graduate students of Clemson University's James C. Kennedy Waterfowl and Wetlands Conservation Center.

CLEMSON STUDENTS MIGRATE TO DEEPEN THEIR WATERFOWL KNOWLEDGE

By Nick Masto and Gillie Croft

Each year hundreds of thousands of ducks, geese and swans winter along the Mid- and South- Atlantic Coast of the United States. There they use natural and managed tidal wetlands, moist-soil impoundments, flooded croplands, lakes, rivers, bays, hardwood bottomlands and other wetlands. But as early as mid-February, the birds begin departing northward to their breeding grounds.

This seasonal migratory cycle means that waterfowl ecology and management majors at South Carolina's Clemson University only get first-hand exposure to local birds during winter. To diversify students' research and field experiences, Rick Kaminski — director of Clemson University's James C. Kennedy Waterfowl and Wetlands Conservation Center — took our group of 10 wildlife, forestry, and environmental and natural resources majors to two geographically important stop-over and wintering areas for ducks on the Atlantic flyway.

The five-day trip to the Chesapeake and Delaware Bays over the 2018 school spring break was part of a creative inquiry course on waterfowl and wetlands. In a typical academic year, students spend countless hours in activities such as processing, drying and weighing submersed aquatic vegetation samples or monitoring wood duck (*Aix sponsa*) nest boxes on campus. The course also includes a field trip to the Lowcountry of South Carolina, an important coastal area for migrating and wintering waterfowl.

The opportunity to visit waterfowl habitats along the Delmarva Peninsula not only enhanced our profes-

▸ During a spring break trip, Clemson students enrolled in a creative inquiry course on waterfowl and wetlands prepare to net two green-winged teal caught in a swim-in trap at Delaware's Woodland Beach Wildlife Management Area.

Credit: Justyn Foth

▲ Clemson students Jess Eidson and Caroline Sharpe (left to right) hold three captured green-winged teal and a black duck.

sional experience and knowledge but also created lasting memories and relationships.

Beyond the classroom

Day 1. On March 16, our group, fondly named "Team Duck," departed from campus. We crossed the Chesapeake Bay roughly eight hours later. There we stopped to observe hundreds of birds, including surf and black scoters (*Melanitta perspicillata* and *M. americana*), long-tailed ducks (*Clangula hyemalis*), bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), scaup (*Aythya* spp.), and other waterbirds.

Upon arriving at Burnt Ducks Hunt Club near Dover, Del., Dr. Justyn Foth, a former student of Dr. Kaminski's, greeted us. The club would serve as our home base for the duration of the trip. Exhausted from the drive, we enjoyed pheasant stew prepared by Dr. Foth and later listened as he spoke of the history of the hunt club and his role as Delaware's waterfowl and gamebird biologist. We learned how revenues from the sales of firearms and ammunition fund the Federal Aid in Wildlife Restoration Act that enables Delaware and other states to address their wildlife habitat and population management needs. Dr. Foth also explained that part of his job involves cooperative conservation efforts with the U.S. Fish and Wildlife Service, Ducks Unlimited, Inc., and other partners.

Day 2. The next day, we rose early to check and bait swim-in duck traps. Dr. Foth, who is licensed by the USFWS to capture and band waterfowl, erected and baited the traps in wetlands on Burnt Ducks and on the nearby Masten's Duck Club and Woodland Beach Wildlife Management Area before we arrived. One trap contained five American green-winged teal (*Anas crecca*), one American black duck (*A. rubripes*), and a gadwall (*Mareca strepera*). We had the opportunity to band the birds, and Drs. Kaminski and Foth showed us how to age and sex live birds using cloacal and wing-covert feather examinations — essential skills for students seeking biologist positions post-graduation.

Next, we traveled to the Havre de Grace Decoy Museum. Located on the banks of the historic Susquehanna Flats, the city of Havre de Grace, Md., is considered the "Decoy Capital of the World." Everyone was awed by the cultural and historical significance of the area to the art of decoy carving as well as to the now illegal practice of waterfowl market hunting.

We also had the opportunity to meet a well-known local carver, Joey Jobes, who invited us to his decoy factory. The shop where he has carved decoys for over 50 years is located behind his childhood home. Mr. Jobes demonstrated his painting skills on a northern shoveler (*Spatula clypeata*) decoy and demonstrated the carving process, which involves using a lathe to construct the body of the decoy, carving and attaching the head and painting the decoy in realistic detail. To support waterfowl research and conservation, Mr. Jobes, like many carvers, donates decoys to conservation organizations such as the Delta Waterfowl Foundation that sell them to raise money.

Day 3. Early the next morning, we returned to the baited sites for more duck trapping and banding. We also met Craig Rhoads, habitat program manager for the Delaware Division of Fish and Wildlife at the Ted

Fostering Waterfowl and Wetlands Education

Clemson University, through the James C. Kennedy Waterfowl and Wetlands Conservation Center, is fortunate to offer unique classroom and field experiences in waterfowl and wetlands management at a time when other university-based waterfowl programs have been in decline. (Kaminski 2013). Kennedy, an avid conservationist who strongly believes in the training of the next generation of waterfowl professionals, has endowed waterfowl programs not only at Clemson University, but also at Mississippi State University, University of Wisconsin-Stevens Point and Colorado State University.

Harvey Conservation Area. Strolling along the newly renovated levee of a 400-acre managed impoundment, we saw hundreds of ducks, wading birds and shorebirds. Mr. Rhoads explained their water management regimes involving new water control structures and hunting regulations at Ted Harvey Conservation Area. He also discussed the area's ongoing $3 million improvement projects to fix impoundments following levee breaches and the destruction of water control structures in the aftermath of Hurricane Sandy in 2012.

To top off an already full day, the group stopped at Bombay Hook Farms. Along the way, we saw thousands of snow geese (*Anser caerulescens*) foraging in agricultural fields. Pete McGaffin, co-owner of the private hunt club, and Ben Vaughn, Delaware's regional director for Ducks Unlimited, met with us to explain the property's management of waterfowl hunting. As we toured the property, they described how they intensively manage impoundments and flood hundreds of acres of croplands to attract migrating and wintering waterfowl.

Day 4. After touring state and privately owned properties, we drove to Bombay Hook National Wildlife Refuge. There we enjoyed a lecture on the history and current management of Bombay and Prime Hook National Wildlife Refuges by Susan Guiteras, a wildlife biologist for the Coastal Delaware National Wildlife Refuge complex, and Jake McPherson, a Ducks Unlimited regional biologist for Delaware, Maryland and West Virginia. They talked about collaborative efforts to restore and manage wetland impoundments on the refuges involving biologists, managers and engineers.

Ms. Guiteras also guided us through the refuge where she explained how managers control the coastal and freshwater impoundments. A final stop was at an observation tower where we viewed the property and hundreds of migrating tundra swans (*Cygnus columbianus*).

At nearby Prime Hook on the Delaware Bay — once home to the largest freshwater impoundment east of the Mississippi River — we learned more about management of a coastal refuge. The aftermath of Hurricane Sandy left refuge managers with a tough decision: should they rebuild the previous freshwater impoundment or restore the nearly 4,000 acres to its natural landscape? Ms. Guiteras, along with

Credit: Rick Kaminski

◂ "The dean of Havre de Grace decoy makers," Madison Mitchell, carved tens of thousands of decoys throughout his 60-year career. A re-creation of his workshop and many of his carvings are on display at the Havre de Grace Decoy Museum in Maryland.

Credit: Nick Masto

◂ Clemson student Robert Leland holds a gadwall while Justyn Foth demonstrates banding techniques.

Credit: Susan Guiteras

▸ Ten Clemson students followed migrating ducks during a 2018 spring break trip to the Delmarva Peninsula. Left to right: Gillie Croft, Robert Leland, Nick Masto, Cameron Massey, Justin Theo, Richard Coen, Caroline Sharpe, Jessica Eidson, Ryan Frazier, Tristan Turner, and trip leader and advisor Rick Kaminski.

Dr. Al Rizzo, refuge manager for the Coastal Delaware National Wildlife Refuge complex, explained the USFWS' decision to restore the impounded freshwater wetlands to natural salt marsh through a federally funded $40 million restoration project. After a frigid tour of the newly restored beach, we convened at the visitor center for a question-and-answer session with our guides about the ins and outs of obtaining a wildlife ecology and management job with the USFWS and other federal outlets. According to Dr. Rizzo, a key strategy is to get your foot in the door. He urged us to explore USAJobs.gov for federal employment opportunities in fire suppression and prescribed burning — two areas with an abundance of jobs nowadays — as a way to establish a USFWS career. This discussion and first-hand advice were especially valuable to our group who soon will enter the competitive wildlife job market.

A Distinguished Waterfowl Researcher and Mentor

Credit: Justyn Foth

▲ Rick Kaminski, shown here with Caroline Sharpe and Jess Eidson (left to right), has organized many hands-on learning experiences for wildlife students.

Rick Kaminski has escorted students on many field trips during his nearly 40-year career studying waterfowl habitats and populations. In addition, he has organized workshops for the public and private sectors on waterfowl and wetlands management and youth waterfowl hunting workshops and guided hunts. He continues to teach waterfowl ecology and management through Clemson University's online master's degree program in Wildlife and Fisheries Biology and advise graduate students.

Kaminski, a TWS Fellow, has received numerous awards for his conservation work, including The Wildlife Society's Caesar Kleberg Award of Excellence for applied wildlife research, the national Blue-winged Teal Award from the USFWS, Ducks Unlimited's lifetime conservation achievement award, and others. Outdoor Life magazine also named Kaminski to a group of 25 North Americans who have made significant contributions to hunting and wildlife conservation. In 2015, he was named as the first director of Clemson University's James C. Kennedy Waterfowl and Wetlands Conservation Center.

One of many messages that Kaminski drives home with his students is the importance of understanding and fulfilling resource needs and habitat management throughout waterfowl's annual cycle and range. He strongly endorses the North American Waterfowl Management Plan as the greatest functional example of an eco- and human-systems approach to conserve waterfowl and other wildlife.

With a few hours of sunlight left, we had some time to shoot clay birds at our home base. For some members of the group who did not have hunting experience, it was an opportunity to learn about safety and shooting techniques from Dr. Kaminiski, a seasoned waterfowl hunter.

Day 5. On the last day of the trip, we were slated to tour Patuxent Wildlife Research Center in Laurel, Md. Unfortunately, we had to cancel the visit due to power outages resulting from Winter Storm Toby. There we planned to meet with federal scientists and learn about their sea duck research, analysis of waterfowl banding data and population modeling, and other current research at the center. We also missed meeting with Dr. Chris Williams, who leads a waterfowl and gamebird ecology and management program for the University of Delaware.

Happy and wiser

When the group arrived back at Clemson around midnight, everyone was exhausted after migrating nearly 2,000 miles. However, our spirits were high. We had gained a wealth of new knowledge and perspectives on waterfowl ecology and management during this non-classroom educational excursion.

The experiences and lessons from Team Duck's 2018 spring break will stay with us throughout our careers and lives. For many students, it was the first time witnessing waterfowl management outside of South Carolina. Plus, everyone gained hands-on experience with essential skills — such as trapping, banding, aging and sexing birds — for becoming a waterfowl biologist anywhere in the country. The trip also strengthened connections with fellow students and helped us develop relationships with professionals in waterfowl management like Dr. Foth.

As future wildlife professionals, we cannot think of a better way for wildlife education programs to train prospective waterfowl biologists, researchers, and stewards than to offer students opportunities to supplement classroom learning with *real* experiences.

Nicholas M. Masto, BS, is a graduate student studying wildlife biology at Clemson University in the Department of Forestry and Environmental Conservation, a Kennedy Center fellow, and a member of the South Carolina Student Chapter of The Wildlife Society.

Gillie Croft, MS, is a wildlife biologist with Nemours Wildlife Foundation, having recently completed his studies at Clemson University in the Department of Forestry and Environmental Conservation.

Clemson Tigers' Spring Migration

Nathaniel Schmidt and Robert "Castles" Leland, Undergraduate Wildlife Student Interns
James C. Kennedy Waterfowl & Wetlands Conservation Center
Department of Forestry and Environmental Conservation
Clemson University

Annual migrations by birds and other wildlife are adaptive and awe-inspiring for ecologists to observe. As weather warms, millions of waterfowl and other waterbirds exhibit Zugunruhe—a German word meaning an anxious behavior to migrate. Like many waterfowl and other waterbird enthusiasts, 14 undergraduate students enrolled in Clemson University's Creative Inquiry Course and interns of the James C. Kennedy Waterfowl & Wetlands Conservation Center were anxious to migrate during our spring break in March 2019. These "Kennedy Kids," as we are affectionately known, departed campus and dispersed northward to North Carolina's Outer Banks to visit state wildlife areas, National Wildlife Refuges (NWR), and Pine Island Sanctuary and Audubon Center in coastal North Carolina. We were chaperoned by our advisors, Nicholas Masto, M..S. graduate student, and Dr. Rick Kaminski, Professor and Director of the Kennedy Center. The following is a summary of our migration.

On Friday March 15th, we arrived at the Outer Banks, Kitty Hawk, NC. We saw sand dunes, maritime scrublands and forests, beach, and brackish marshes. We also were amazed by the density of human development and tourism in this region in spite of recent hurricanes and increasing sea-level rise along the Atlantic Coast.

On Saturday, March 16th, we began our scheduled experiential learning opportunities, the first of which was a visit to Donal C. Obrien Sanctuary and Audubon Center at Pine Island, NC. We were greeted by Dr. Robbie Fearn, the Center's Director, who escorted us behind the gates of the Center. He explained the national historical and conservation significance of this property, which has hosted waterfowl hunting for over a century and now is providing opportunities for wetland systems research. Dr. Fearn explained the philosophy of understanding and accepting ecosystem change over time and emphasized wetland movement, transition, and management to mitigate impacts of climate change and sea-level rise. Additionally, the property contained a red bay (*Persea borbonia*) dominated scrub community, which, according to Dr. Fearn, is one of the rarest plant communities in the world. After speaking with Dr. Fearn, we hiked along a nature trail. We observed several species of waterfowl including greater scaup (*Aythya marila*), black ducks (*Anas rubripes*), American green-winged teal (*A. crecca*), and Canada geese (*Branta canadensis*). Stopping at an idled former crop field, Dr. Kaminski discussed how the field easily could be transformed into a site for dove hunting, emphasizing the importance of gamebird species other than waterfowl on this island. Additionally, he shared his insight as we walked along a wet meadow of broom sedge (*Andropogon virginicus*). He lectured that broom sedge is a late successional grass species with little value for waterfowl. A combination of burning and disking would encourage germination of early successional moist-soil plants from the native seed bank, which would then provide food and cover for waterfowl and other birds.

Next, we drove to Pea Island NWR. There, we saw an abundance of waterfowl and American coots (*Fulica americana*). Shortly after arriving, we espied a river otter (*Lutra canadensis*) with a drake gadwall (*Mareca strepera*) firmly in its grasp and swimming with it like a retriever. The otter held our attention for much of our remaining time at

Pea Island NWR, and one student, David Singletary, snapped an excellent photograph of this predator with its prey.

Additionally, Dr. Kaminski quizzed us on wildlife tracks and scats. We also found the skeleton of a shorebird, which we identified as such by the length of its tibiotarsi. Afterwards, we stopped at Oregon Inlet, a world-recognized inlet for its dangerous waves and currents that have sunk many sport fishing ships.

On March 17th, we traveled inland to tour North Carolina Wildlife Resources Commission's J. Morgan Futch Wildlife Gamelands, where we met David Turner, the Commission's Northern Coastal Management Biologist. We toured the facilities, including a handicap hunters' duck blind, eight moist-soil wetland impoundments, and six catfish ponds which were converted and managed to promote growth of submerged aquatic vegetation (SAV) for waterfowl. During the tour, students engaged Mr. Turner in discussion of moist-soil management, waterfowl hunting and harvest, nuisance wildlife, aquatic plant management, and the area's cooperative farming program. The program allows farmers to grow and harvest agricultural crops on this state land; however, farmers must leave about 10% of crop for use by waterfowl and other wildlife. Mr. Turner informed the students of nuisance aquatic plant and wildlife species including alligator weed (*Alternanthera philoxeroides*) that clogs pumps and channels, muskrats (*Ondatra zibethicus*) and nutria (*Myocastor coypus*) that tunnel into dikes, and black bear (*Ursus americanus*) that depredate crops, ransack cabs of heavy equipment, and chew holes in rubber hydraulic fluid hoses of pumps. Thus, pumps must be surrounded by chain-link fences. Mr. Turner believed the bears rolled in hydraulic fluid perhaps to help repel insects from their pelage. Lastly, Mr. Turner discussed legislative roles in operation and management of state wildlife lands. We enjoyed an outdoor lunch with Mr. Turner and then followed him to Texas Plantation, another managed state gameland.

Texas Plantation is managed similarly to J. Morgan Futch, although it is currently being renovated. Renovations included additional impounded wetlands and installation of new infrastructure to prevent alligator weed from entering and clogging water management and pumping stations. This device consisted of a perforated metal grate in a sliding channel mounted in the canal; the grate was designed to collect floating vegetation before entering and clogging infrastructures. Mr. Turner also discussed their great partnership with Ducks Unlimited, Inc. on this and other wetland projects in North Carolina.

On Monday, March 18th, we visited North Carolina's Goose Creek Gamelands, where we met Mr. Rickie Clark, the Commission's Central Coastal Management Biologist. Mr. Clark gave the students a brief history of Goose Creek Gamelands, which originally was created for mosquito control and later converted to managed wetlands for production of SAV for wintering waterfowl. After the history lesson, we traveled to an observation tower where we observed impacts of saltwater intrusion on a former freshwater forested wetland and a variety of waterfowl, including American wigeon (*Mareca americana*), black ducks, and blue-winged teal (*Spatula discors*). Mr. Clark discussed management challenges, such as invasive plant species, natural disasters, and wind and boat wave action that causes significant dike damage. After observing a significantly eroded dike along the Intracoastal Waterway, we traveled to Pocosin Lake NWR.

Upon arriving at Pocosin Lake, we met Ms. Sarah Watts, Refuge Volunteer and Program Coordinator. During lunch, Ms. Watts provided us a brief history of the Pocosin Lake NWR. The word Pocosin, is a Native American term for "swamps on a hill," where peatlands were geologically formed in this area. Ms. Watts also discussed the importance of carbon sequestration by the peatlands, as well the history and reintroduction of red wolves (*Canis rufus*). Pocosin NWR also has a cooperative farming that provides corn and other croplands for migratory waterfowl. After lunch, Ms. Watts led us on a driving tour of the refuge in which we saw croplands, forested wetlands, and managed marshes. After the tour, Dr. Kaminski led us in a critical thinking exercise in which we discussed possible ecological explanations for cross-continental migration of tundra swans (*Cygnus columbianus*) that winter in abundance at this refuge and elsewhere in the Atlantic coastal region. These large-bodied birds breed in Alaska and migrate southeasterly across the continent to winter in coastal North Carolina. We proposed several theories for this cross-continental migration, but there was consensus that perhaps the birds' foraging dependence on aquatic vegetation in lakes and other wetlands from Alaska to the Atlantic coast influenced evolution of their cross-continental migration.

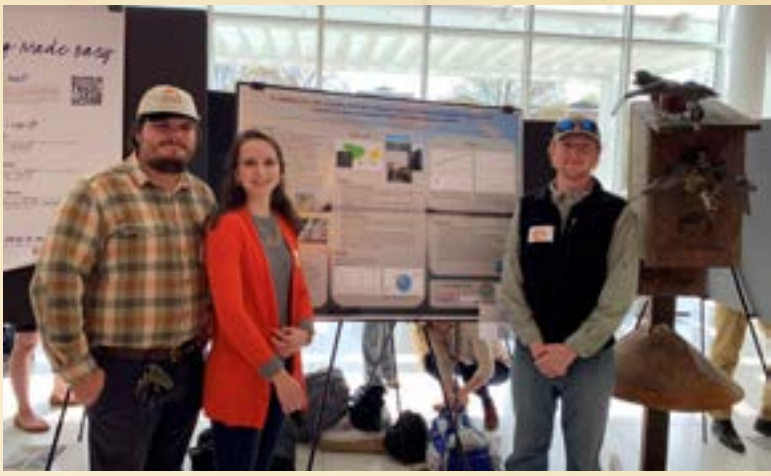
We spent Tuesday, March 19th at famed Mattamuskeet NWR, where we were welcomed by Ms. Wendy Stanton, Refuge Biologist. Ms. Stanton shared an informative presentation, depicting management challenges faced at Mattamuskeet NWR—most of which link to the Lake's increasing salinity. Lacking ability to manage hydrology adequately, coupled with pressure from local farmers to maintain freshwater for irrigation, salinity, eutrophication, and algal blooms are significant influences on the decline in SAV for wintering waterfowl and coots. We discussed problems associated with decreased SAV coverage including foraging carrying capacity for the nearly 60,000 tundra swans and 200,000 ducks that winter in the area. Because of decreased SAV, swans and geese now forage in corn fields on and off the refuge. Afterwards, Ms. Stanton discussed the value of volunteer and paid work experiences to "get your foot in the door" to earn a federal or other job in natural resources. We rounded out the trip at a local restaurant for lunch and more discussion before migrating back to Clemson, SC.

As we returned to Clemson and completed our migration, an unspoken satisfaction and appreciation permeated the vans. We understood what a privilege and opportunity we were afforded through the Kennedy Center; Clemson University Creative Inquiry Program; our chaperones, Nick Masto and Dr. Kaminski; and the North Carolina state, federal, and privately affiliated hosts. We were happy to spend our spring breaks to travel and enhance our waterfowl and wetlands education in North Carolina. Rarely do campus classes offer experiential opportunities such as the ones we have described. Each of us cherish this experience, those with whom we shared it, and the opportunity and impact of it on our education and future careers.

All 16 members of Clemson University's James C. Kennedy Waterfowl and Wetlands Creative Inquiry spring break trip shown here at the Donal C. Obrien Sanctuary and Audubon Center at Pine Island, NC. Left to right: David Singletary, advisor Dr. Rick Kaminski, Marcus Dudley, Colby Taylor, Jess Eidson, Chandler Gray, Tristan Turner, Amanda Taylor, Granger Rabon, Colin Farah, Caleb Watson, Stephanie Braswell, Nathaniel Schmidt, Castles Leland, Richard Coen, and Nick Masto.

UNDERGRADUATE RESEARCH ACTIVITIES

Nicholas Masto, Kennedy Center M.S. Graduate Fellow, and Dr. Kaminski co-led fall and spring semester Clemson Creative Inquiry courses that attract about 15 undergraduate students annually to engage and assist faculty and graduate students in waterfowl and wetlands research and thereby earn course credit and experience in conducting research while undergraduate students. The following abstracts summarize two research projects conducted by the students and their supervisors, Nick Masto and Dr. Kaminski. The first abstract and an associated poster on rake-sampling to estimate aquatic plant biomass received a **2nd place award** among over 150 student posters presented at Clemson University's Undergraduate Student Research Forum in April 2019.



Castles Leland (left), Caroline Sharpe, and Tristan Turner, three of the student award winners and co-authors of the poster, pose in front of the poster at the Forum.

Garden-Rake Sampling to Estimate Biomass of Submersed Aquatic Vegetation in South Carolina Managed Coastal Wetlands

Caroline Sharpe, Castles Leland, Tristan Turner, Stephanie Braswell, Jess Eidson, Colin Ferrah, Caleb Watson, J. C. Tolson, Nicholas Masto, and Dr. Richard Kaminski
Department of Forestry and Environmental Conservation
James C. Kennedy Waterfowl & Wetlands Conservation Center
Clemson University

Managers of brackish, impounded wetlands in coastal South Carolina manipulate water depth, duration of flooding, and salinity to stimulate growth of widgeongrass (*Ruppia maritima*) and other submersed aquatic vegetation (SAV), which provide forage for waterfowl and other waterbirds during fall and winter. Researchers require accurate and efficient methods to estimate SAV biomass in these impoundments and other wetlands to determine their foraging carrying capacity for migrating and wintering waterfowl. These biomass estimates are used in habitat conservation planning and implementation by the Atlantic Coast Joint Venture and partners of the North American Waterfowl Management Plan. We evaluated use of a garden rake to predict total and species-specific SAV biomass within five managed impoundments at Bear Island Wildlife Management Area (32.6130° N, 80.4438° W) in the Ashepoo-Combahee-Edisto Rivers Basin of South Carolina. Additionally, we evaluated effects of soil firmness and water depth on SAV biomass at sample sites in these impoundments. In August 2016, Nick Masto collected 10 random samples of SAV and associated abiotic variables within each of

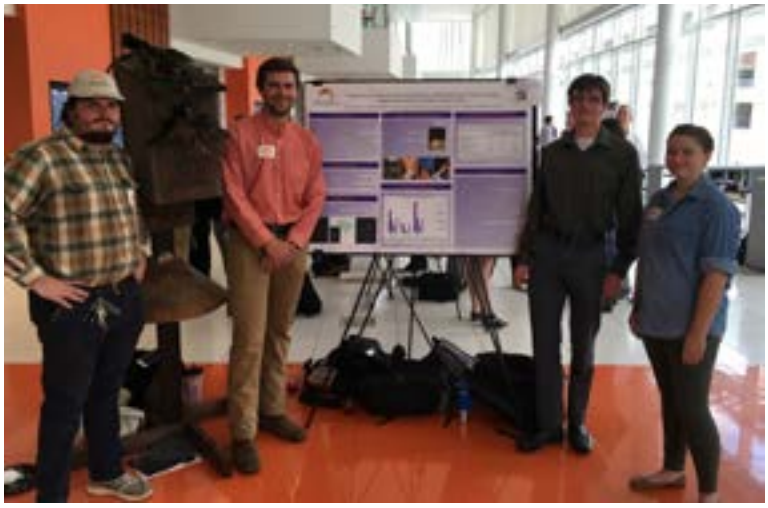
the five impoundments (n = 50), using a non-modified flat head garden rake and by hand to harvest remaining SAV not collected with the rake within a 0.2-m^2 contained quadrat (i.e., rake sample + hand-grabbed sample = total SAV biomass). Additionally, Nick used a soil penetrometer and a meter stick to measure soil firmness and water depth at each sample site, respectively. We calculated rake efficiency ([dry-weight of rake samples/dry-weight of total SAV samples] * 100), SAV percent species presence ([sites occupied by species x/n sites] * 100), overall species composition, and used linear mixed model regression to evaluate the rake sampling method and associated abiotic variables in predicting total and species-specific SAV biomass. We collected three SAV species, including widgeongrass (78%), muskgrass (*Chara* sp.; 14%), and dwarf spikerush (*Eleocharis parvula*; 8%). Rake efficiency overall was 76% for total SAV biomass and ranged from 69–77% for individual SAV species. Widgeongrass was present at 86% of sample sites, muskgrass at 50%, and dwarf spikerush at 22%. Rake samples explained 95% of the variation in total SAV biomass. Additionally, rake samples explained 95% of the variation in widgeongrass biomass, 97% in dwarf spikerush biomass, and 97% in muskgrass biomass. Abiotic variables did not predict total or species-specific SAV biomass significantly more than rake-sample biomass alone. We concluded rake sampling predicted total and species-specific SAV biomass well, with little unexplained variation. Managers and researchers can use our rake method, species composition, and regression equations to estimate SAV biomass in South Carolina coastal impoundments, but evaluation of our methods elsewhere is recommended.

Wood Duck Use of and Production in Nest Boxes on Clemson University's Experimental Forest in the Piedmont Region, South Carolina

David Singletary, Nathaniel Schmidt, Amanda Taylor, Jordan McCall, Granger Rabon, Marcus Dudley, Chandler Gray, Nicholas Masto, and Dr. Richard Kaminski
Department of Forestry and Environmental Conservation
James C. Kennedy Waterfowl & Wetlands Conservation Center
Clemson University

Evaluating wood duck (*Aix sponsa*) and other avian use of and production in artificial nest boxes was identified as a research priority by wildlife biologists from mid-south Atlantic flyway states at a 2018 workshop at the Nemours Wildlife Foundation in Yemassee, South Carolina. Additionally, a large-scale recent study in coastal South Carolina evaluated duck and other bird use of and production in artificial boxes (Croft 2018, Thesis, Clemson University), but no similar recent study has been conducted in this century in the northern Piedmont Region of the state. As part of a Clemson University's Creative Inquiry undergraduate research course in 2018-2019, we are monitoring wood duck boxes in Clemson's Experimental Forest (30,351 ha) in the Piedmont Region. Our objectives are to: 1) establish protocols for monitoring and maintaining these and additional nest boxes for future undergraduate student researchers, 2) determine nest box use (≥1 egg) and reproduction (≥1 egg-shell membrane) by wood ducks and other birds, 3) evaluate variables that predict probability of use of nest boxes by wood ducks and other birds, and 4) compare results between piedmont, coastal, and other regions in South Carolina and southeastern United States. We monitored nest boxes biweekly from January–August 2018–2019, following the protocol of Croft (2018). Our study area included

two distinct areas, including the North (n = 21 boxes) and South (n = 24) tracts of Clemson Experimental Forest. We will determine internal volume of each nest box, height of boxes from entrance to ground or water, water depth, nest-box entrance area and shape (circle or ellipse), and canopy cover. We will use nest-box measurements to predict probability of nest box use by wood ducks. Preliminary results from 2018 revealed that wood ducks used 52% of the boxes in the South Forest; these contained a total of 375 eggs and an average clutch size of 22 eggs per box. In comparison, 36% of the boxes in the North Forest were used; these contained 63 eggs and an average clutch size of 13 eggs per box. We posit greater use and egg production in the South Forest resulted from nest boxes being conspicuously located over open water, which may have attracted multiple hens to lay eggs in individual boxes and enlarge clutches beyond normal size. Although conspicuous boxes in the South Forest produced increased numbers of eggs, these boxes are in wetlands with predatory fish and little emergent cover. Recruitment by female wood ducks nesting in boxes should be studied to determine if boxes are sustaining wood duck populations in the Clemson Forest and across North America. A region-wide study across southeastern United States by the Nemours Wildlife Foundation, Kennedy Center, and other states' partners will commence in 2020 to address this issue. Currently, the South Carolina Department of Natural Resources, Nemours Wildlife Foundation, and the Kennedy Center are conducting a pilot study at Lake Moultrie near Bonneau, South Carolina to evaluate techniques before initiating the regional study in 2020.



Castles Leland (left), David Singletary, Nathaniel Schmidt, and Amanda Taylor commanding Team Wood Duck's poster at the 2019 Clemson University Undergraduate Research Symposium.

RESEARCH ABSTRACT

Effects of hydrological management atrategies for aubmersed aquatic vegetation and invertebrates in South Carolina coastal impoundments

Beau A. Bauer, M.S., Wildlife Biology, Clemson University, December 2018
Staff Wildlife Biologist, Nemours Wildlife Foundation

Widgeongrass (*Ruppia maritima*) is a native species of submersed aquatic vegetation (SAV) found in brackish wetlands around the world. Management of SAV is practiced in impounded tidal wetlands (former historic rice fields) in coastal South Carolina to provide forage for waterfowl and other waterbirds. Widgeongrass also provides habitat for aquatic invertebates and attached algae and microbes eaten by invertebrates. I conducted an experiment to evaluate effects of complete drawdown to dried substrate versus partial drawdown to mud or several inches of water during May–June 2016 on aquatic invertebrate and SAV biomasses and invertebrate diversity in managed brackish tidal impoundments in the Ashepoo, Combahee, and Edisto Rivers Basin, South Carolina. Such data were lacking to inform managers of best practices to promote standing crops of SAV and invertebrates. I sampled sediments and SAV in eight completely and twelve partially dewatered impoundments and three non-impounded natural tidal marsh sites in August 2016, November 2016, January 2017, and April 2017. The SAV and invertebrate biomasses at peak production in August were greatest and less variable in partially drawndown impoundments before Hurricane Matthew devastated SAV communities in October 2016. Nonetheless, partially drawndown impoundments contained greater invertebrate biomasses and diversity for most sampling periods. I also determined that partially drawdown impoundments had about three times greater potential foraging capacity for dabbling ducks than completely drawndown impoundments. I recommend partial drawdowns to maximize invertebrate and SAV biomasses and foraging carrying capacities for ducks and other waterbirds in managed coastal impoundments in South Carolina. However, I also recommend complete drawdowns every 2-3 years to consolidate soils and decompose organics to promote rooting by SAV. My study provided initial information to guide future similar research, management, and duck foraging studies in the south Atlantic Flyway.

Beau Bauer and his family, all sharing Beau's completion of his M.S. degree and graduation from Clemson University.

RESEARCH ABSTRACT

Reproduction and nest-box use by wood ducks and black-bellied whistling ducks in coastal South Carolina

Gillie D. Croft, M.S., Wildlife Biology, Clemson University, December 2018
Wildlife Biologist, Nemours Wildlife Foundation

I surveyed nest-structure use, duckling production, and other metrics of reproductive ecology of wood ducks (*Aix sponsa*), black-bellied whistling ducks (*Dendrocygna autumnalis*), and hooded mergansers (*Lophodytes cucullatus*) across two South Carolina coastal regions during 2016–2017 (Croft 2018, Thesis, Clemson University). Wood ducks used the greatest proportion of >350 monitored boxes (61%), followed by black-bellied whistling ducks (15%) and hooded mergansers (< 1%). Wood ducks initiated nesting in January, well before black-bellied whistling ducks did in May. Peak nesting occurred in March and April for wood ducks and June for black-bellied whistling ducks. I found two hooded merganser nests in boxes during my study, one was initiated in February and the other not discernible.

Based on phenology of nesting wood ducks and black-bellied whistling ducks, I speculate little competition occurs for nest boxes between the species because overlap of nesting occurs only in June–July. Additionally, average percent use, number of eggs per box, and number of ducklings exiting boxes were greater for wood ducks than black-bellied whistling ducks (61% vs. 15%, 8 vs. 2 eggs, 5 vs. 1 duckling[s]).

Gillie Croft displaying his M.S. diploma from Clemson University

Nest box size and canopy cover above boxes influenced box use by wood ducks and black-bellied whistling ducks. Wood ducks selected boxes with smaller internal volumes, whereas black bellied whistling ducks did oppositely. My results indicated the size of the conventional nest box described by Bellrose (1980) was used by both species of ducks and therefore can be deployed where these species co-exist. Where the species are sympatric, I suggest nest box entrances should have 5-inch diameter to facilitate use by larger bodied black-bellied whistling ducks. Additionally, I found both species of ducks preferred to use boxes in "open" canopy wetlands, which often contained fish that prey on ducklings and may be an "ecological trap" for ducklings. Therefore, I recommend nest boxes be placed along shorelines with emergent or scrub-shrub vegetation to provide cover and promote duckling survival and recruitment.

Lastly, I assessed cost of female wood duck recruits from nest boxes, based on expenditures to fabricate boxes, their annual maintenance, an assumed longevity of 20 years for an annually maintained box (total = $143.23/box [U.S. 2018]), reproductive metrics from my study, and a wood duck female recruitment rate of 6% (Hepp and Kennamer 2012). The cost per female wood duck recruit was $59.68, which was 2.4 time less than the cost of the box, mounting structure, predator shield, and maintenance over 20 years. Therefore, nest boxes in my study may be cost-effective, but female recruitment rates should be estimated cross-flyways to determine cost-efficiency of wood duck nest box programs.

RESEARCH ABSTRACT

Aerial strip-transect surveys for monitoring waterbird populations in South Carolina

Nicholas M. Masto, M.S. Student, Clemson University
Molly R. Kneece, Wildlife Biologist, South Carolina Department of Natural Resources

Nick Masto (right) during a 2019 aerial survey in the air somewhere over South Carolina. We sincerely thank our expert pilot, Garrett Wilkerson (left), U.S. Fish and Wildlife Service pilot-biologist.

Aerial surveys are an effective and cost-efficient method for quantifying population and habitat dynamics of waterfowl and other waterbirds across vast and especially inaccessible landscapes, understanding influences of environmental and anthropogenic change, and managing waterbird populations for protection, sustainable harvest, species recovery, and other conservation needs. In response to cessation of the Midwinter Waterfowl Survey in 2016 and need for reliable surveys of wintering waterbird populations in South Carolina, we conducted fixed-wing, 250-m wide aerial strip-transect surveys for waterbirds during falls 2016–winters 2019. To our knowledge, South Carolina is the only state in the Atlantic Flyway currently conducting probability-based aerial surveys to monitor migrating and wintering waterbirds inland of the Atlantic Ocean. We revised survey strata following 2016–2017 surveys by excluding forested uplands (51%) and swamps (47%) that did not provide habitat or precluded detection of waterbirds, human populated areas (e.g., 51% and 31% agricultural–rural and suburban–metropolitan areas, respectively), and no-fly zones. Revision of survey strata reduced surveyed area by nearly 38% (9,132.74 km2 to 5,676.08 km2) while retaining 95% of all 2016–2017 waterbird detections. We conducted aerial surveys of revised strata during falls 2017–winters 2019, and allocated sampling effort proportionately to stratum area and within fiscal budgets (7.5–10%). We estimated population indices ($\hat{I}$; abundance not corrected for detection bias) for eight waterbird categories, including dabbling ducks, diving ducks, total dabbling and diving ducks, geese and swans, coots and gallinules, pelagic and piscivorous waterbirds, raptors, and wading birds. Estimated abundance of all duck species combined ranged from 1,558–102,421 birds (24% ≤ CV ≤ 46%; [CV = (SE/ $\hat{I}$)] * 100) for fall 2017–winter 2019 surveys, with greatest abundance of ducks observed in January 2019. Wading bird abundance was greatest in September and November 2017–2018, ranging from 13,065–26,339 birds (13% ≤ CV ≤ 43%). Wood storks, a threatened species in its range, were detected in greatest abundance in Septembers 2017 and 2018 in the Port Royal stratum. Pelagic waterbird abundance ranged from 5,281–16,581 birds (18% ≤ CV ≤ 47%), with at least 11,572 birds estimated among all surveys except for September 2017 ($\hat{I}$ = 8,047) and January 2018 ($\hat{I}$ = 5,281). Double-crested cormorants were detected in greatest abundance in February 2018 and January 2019, with most birds observed in Santee Lakes stratum during 2017–2018 and in South Winyah–Bulls' Bay stratum in 2018–2019. Our 2017–2019 estimates for total ducks were similar to duck numbers reported for the 2012–2015 Midwinter

Waterfowl Surveys (80,247–135,271; average = 97,272; USFWS 2015). We believe our estimates are reasonable, but survey effort could be increased to achieve targeted goals of statistical precision (CV ≤ 15–20%). Thus, we computed a theoretical survey effort to achieve CV = 20% for all taxa of waterbirds. Estimated effort to achieve desired precision for dabbling ducks averaged 29% (16–45%) across all surveys. Diving ducks needed least effort to achieve desired precision, averaging 15% across surveys (6–26%), followed by pelagic waterbirds (16% [7–26%]), wading birds (20% [4–38%]), and raptors (21% [11–45%]). Excluding November 2017 and September 2018 surveys, when variance and estimated effort were greatest, estimated effort across waterbird taxa for the other seven surveys ranged from 22–25%. Based on these results, increasing survey effort three-fold (i.e., ~66 flight hours = 7.5 days) theoretically would provide desired precision for all taxa of waterbirds. Low precision of waterbird estimates suggests waterbird densities and distributions exhibited significant spatial clustering, as reflected in our graphic spatial distributions of high-density locations of ducks and other waterbirds. We suggest additional stratification of high density waterbird areas, optimal allocation, geographically strategic increased survey effort to improve precision, and simulations to evaluate proposed variance-reduction methods. Additionally, we found evidence of observer (front- vs. rear-seat) differences for pelagic waterbirds in January 2018 ($Z_{0.005}$ = –2.75, P = 0.006) and diving ducks in February 2018 ($Z_{0.005}$ = –2.59, P = 0.001), emphasizing need for consistency between observers and determination of accuracy of observers' counts. Finally, we are modeling detection and abundance with observation and habitat covariates to estimate waterbird abundance adjusted by detection probabilities and effects of habitat on abundance. Preliminary results suggest that observer and group size best describe variation in detection, front- and rear-seat observers exhibit different and taxa-specific detection probabilities, and managed and non-managed coastal historic rice fields/brackish–saline open water/emergent marsh habitats describe greatest variation in abundance across most waterbird taxa. Modeling and all other results will be presented in Nick Masto's thesis, which he will defend in summer 2019.

Denham Masto, four years young, accompanying his father, Nick, in a pirogue to monitor wood duck nest boxes in Clemson University's Experimental Forest (18 May 2019). Indeed, this picture represents recruitment, hopefully both of wood ducks and Denham into the world of waterfowl.

RESEARCH ABSTRACT

Are Wood Duck Box Programs Sustainable?

Jake Merendino, Emily Miller, and Jacob Shurba
Research Technicians, Clemson University and Nemours Wildlife Foundation

From left, Jacob Shurba, Jake Merendino, and Emily Miller, graduates of University of Wisconsin-Stevens Point, Texas A&M University-Kingsville, and State University of New York-Cobleskill, respectively.

Wood ducks nest in natural tree cavities throughout North America. However, artificial nest boxes frequently are used by the species and widely accepted as an effective wildlife management tool.

We are technicians for a pilot study designed to begin estimating wood duck use, duckling production, and recruitment rates by females nesting in boxes around Lake Moultrie near Bonneau, South Carolina. By recruitment rates, we mean the percentages of hens nesting and their female offspring that return in subsequent years to nest in the boxes. These percentage rates are critical to determining if box-nesting populations are sustaining themselves and nest-box programs are cost-effective.

Our project this year is conducted in partnership with the South Carolina Department of Natural Resources and the U.S. Fish and Wildlife Service-Santee National Wildlife Refuge. Our pilot study is intended to develop, refine, and standardize methodology for a multi-state and year collaborative research project across southeastern United States. Colleagues from the University of Delaware and Delaware Division of Fish and Wildlife are conducting a similar pilot study in Delaware in preparation for joining us next year in the regional investigation.

We also are investigating if nest-box placement has an effect on hens' use of boxes. We are recording micro-habitat characteristics at each box. Micro-habitat characteristics include water depth, vegetative cover, and distances from the box to cover and nearest other box. We also are determining if physical characteristics of the boxes influence use of boxes by ducks, such as box volume, direction of the box entrance, and if it is on land or over water. These factors may play a role in female selection of boxes and can be adapted to increase female use of boxes, duckling production, and recruitment.

We are monitoring 166 boxes among six sites around Lake Moultrie. As of late May 2019, female wood ducks deposited eggs in ~80% of monitored nest boxes. We are on our way to over 90% use, as the South Carolina DNR has experienced at this site in recent years. We have noted that boxes not used by wood ducks may be influenced by disturbance from boat traffic, and woodpeckers are puncturing and carrying away wood duck eggs from the boxes. Black rat snakes also are getting their fair share of wood duck eggs. We will implement experiments to evaluate and abate these problems in 2020. By late May 2019, we have newly banded nearly 120 nesting female wood ducks, and over 300 ducklings have been double web-tagged as pictured below. We have our sights set on accomplishing our goal of tagging 400 ducklings at this site this year. Individually marking hens and ducklings will enable us to estimate their return and recruitment rates in coming years.

Are wood duck nest box programs sustainable? We can't address this question yet, but answers will emerge through this unique study across southeastern United States. Stay tuned!

COLLABORATIONS

Collaborative teaching, research, and outreach with colleagues and students from other universities, agencies, and NGOs are a continuing ambition and goal of the Kennedy Center. Such collaborations provide diverse educational and experiential opportunities for all who engage in sharing talents and resources. Indeed, we learn and prosper by our "cross-pollinating."

Dr. Kaminski, Clemson Kennedy Center students, and technicians collaborate closely with the Center's fellow organization, The Nemours Wildlife Foundation (NWF). The NWF hosted two workshops in 2018 at which waterfowl and wetlands research priorities in the southeastern United States were identified and implementation plans initiated by about 30 participating waterfowl and wildlife biologists from mid- to south Atlantic states. As mentioned in the research section, the NWF, the Kennedy Center, the South Carolina Department of Natural Resources, the Delaware Division of Fish and Wildlife, and the

University of Delaware are currently engaged in a pilot study in South Carolina and Delaware to begin investigating recruitment by box-nesting female wood ducks in these states. Additional partnering states, universities (e.g., Mississippi State University's James C. Kennedy Waterfowl and Wetlands Conservation Endowed Program), and U.S. Fish and Wildlife Service's National Wildlife Refuges hopefully will join in a southeast USA-wide study of wood duck recruitment in 2020.

In September 2018, the Michigan Department of Natural Resources (DNR), the DNR's Shiawassee State Waterfowl Management Area (WMA), and Shiawassee National Wildlife Refuge hosted Dr. Kaminski to help conduct a workshop on ecology and management of moist-soil wetlands and croplands for waterfowl at the Shiawassee WMA. Over 30 biologists, managers, waterfowl hunters, and students attended classroom lectures and field trips, which were interuppted by Hurricane Florence that forced Dr. Kaminski to return to South Carolina prematurely from Michigan. Pictured below from left to right are Dr. Harold Prince (retired), Dr. Kaminski's former major professor and mentor during his graduate student days at Michigan State University during the 1970s, Barb Avers, Michigan DNR's waterfowl biologist and former graduate student of Dr. Kaminski at Mississippi State Univeristy, and Kaminski.

Additionally, Mr. Barry Pratt (3rd from left in green shorts), long-time friend of Dr. Kaminski and frequent waterfowl hunter and check-station operator at Shiawassee WMA, gestures while explaining his pleasure with integration of moist-soil management and "grassy" cornfields at the WMA.

The Kennedy Center was represented at Clemson's College of Agriculture, Forestry, and Life Sciences (CAFLS) event in September 2018, when the Clemson Tigers (who are currently the National Champions) hosted and defeated another ORANGE team, Syracuse University. Kennedy Center and Nemours Wildlife Foundation graduate students, Beau Bauer and Nick Masto, and Center-Foundation undergraduate intern, Castles Leland, represented the Center, Foundation, and the Baruch Institute at the event. We were grateful to Nemours Wildlife Foundation for constructing a "traveling trunk," the wooden structure on the trailer which mimics real "trunks" used to manage water levels in South Carolina coastal impoundments. Trunks have been used for centuries in managed tidal impoundments in Lowcountry South Carolina, initially to manage water in rice fields and nowadays to manage hydrology for production of native aquatic vegetation for waterfowl.

Dr. Michael Schummer, former post-doctoral research associate of Dr. Kaminski's at Mississippi State University's (MSU) Kennedy Chair and now Assistant Professor of waterfowl and wetlands at State University of New York's (SUNY) College of Environmental Science and Forestry in Syracuse and other co-authors presented and published a paper at the 2018 Southeastern Association of Fish and Wildlife Agencies' annual meeting (SEAFWA; Mobile, AL). The paper and publication concluded research on Mississippi waterfowl hunters' opinions regarding hunt management and quality conducted by former students, Elizabeth St. James (MSU) and Allison Smith (SUNY). The students, Drs. Schummer, Kaminski, and Kevin Hunt (MSU), and Houston Havens (Mississippi Department of Wildlife, Fisheries, and Parks) co-authored the presentation and publication. Clemson's Kennedy Center sponsored Dr. Schummer's travel and participation in 2018 SEAFWA.

Dr. Kaminski also served SEAFWA by being a professional mentor to students at the conference. Below Dr. Kaminski is pictured with student mentees and other mentors at a SEAFWA luncheon.

Several Kennedy Center Advisory Board members and sagacious waterfowl and wetlands ecologists and managers met at the Baruch Institute to hear and respond to a seminar by Beau Bauer on hydrological management of tidal impoundments for production of widgeongrass, other submersed aquatic vegetation, and invertebrates. The topic was Beau's M.S. thesis research and preceded his thesis defense in November 2018. Seated left from front are R. Kenny Williams, Phil Wilkinson, Michael Prevost, Byron "Bubba" McDaniel, Bill Mace, Jamie Dozier, and Dr. Ernie Wiggers (Nemours Wildlife Foundation). Including Dr. Kaminski and Beau (seated right), over 300 years of wetlands and waterfowl experiences surrounded this table to provide constructive advice to Beau before his thesis defense. Beau graduated in December 2018 and is the staff wildlife biologist for Nemours Wildlife Foundation.

In December 2018, Mr. and Mrs. Paul Bonderson hosted a group of waterfowl students and professionals at their Bird Haven Ranch near Willows, California. In attendance were students and faculty from the endowed James C. Kennedy Waterfowl and Wetlands Conservation programs of Clemson University, Colorado State University, Mississippi State University, and University of Wisconsin-Stevens Point (Kennedy-David Grohne Chair), the Dennis G. Raveling Endowed Chair in Waterfowl Biology of University of California-Davis, University of Nevada-Reno, and employees of the Ranch, California Waterfowl Association, Delta Waterfowl Foundation, Ducks Unlimited, Inc., and Ducks Unlimited-Canada. The primary purpose of the Bird Haven event was to enable students' and professionals' interactions and networking to enhance cross-institutional and flyway collaboration in waterfowl and wetlands teaching, research, and outreach. Besides identifying ways to promote such diverse engagement, the group was treated to fine food and fellowship, including two memorable waterfowl hunts and an evening trail ride through Bird Haven Ranch. Pictures of the group and panoramas at Bird Haven Ranch follow below. Thank you, Mr. and Mrs. Bonderson, for your graciousness in hosting our group, which is committed to advancing the goals of this meeting and those in the article, "Who will mind the marsh?". This article appeared in our 2018 Kennedy Center annual report which can be accessed at: https://www.clemson.edu/cafls/departments/kennedycenter/pdf/kennedy-report-2018.pdf

Dr. Kaminski continues to collaborate with Dr. Brian Davis, Associate Professor of the James C. Kennedy Endowed Chair in Waterfowl and Wetlands Conservation at Mississippi State University (MSU), where Dr. Kaminski was named an Emeritus Professor in the Department of Wildlife, Fisheries, and Aquaculture after retiring from MSU in 2015, following 33 years of service. Drs. Davis, Kaminski, and Jessica Klassen (MSU-WFA post-doctoral research scientist), and Houston Havens (Mississippi Department of Wildlife, Fisheries, and Parks [MDWFP]) are collaborating in analyses and reporting of results from nearly 20 years of aerial surveys by MDWFP of wintering

ducks across the Mississippi Delta. These surveys were begun by Dr. Aaron Pearse in early 2000s for his Ph.D. from MSU-WFA. Dr. Pearse is a research scientist at USGS Northern Prairie Wildlife Research Center in Jamestown, North Dakota.

Dr. Davis traveled to Clemson University in January 2019 and was the keynote lecturer for the Department of Forestry and Environmental Conservation, Natural Resources Graduate Student Association's weekly seminar. Dr. Davis lectured on campus and at the Kennedy Center at the Baruch Institute in Georgetown. His topics included mallard wintering ecology in Mississippi, based on Dr. Joe Lancaster's doctoral research, and ecology and conservation of terraces constructed in the Louisiana Gulf Coast to promote accretion of marsh and aquatic vegetation in the face of sea-level rise. Dr. Kaminski served as co-major professor to Dr. Lancaster. Drs. Lancaster and Davis are pictured at MSU's spring 2018 commencement exercise.

Dr. Kaminski continues collaborations with Dr. Phil Lavretsky of the University of Texas-El Paso. Dr. Lavretsky is a renowned waterfowl geneticist, who is investigating genetics of North American ducks, including mottled ducks which inhabit South Carolina and the Gulf of Mexico Coast. The South Carolina Department of Natural Resources is funding Dr. Lavretsky's DNA analyses of mottled to determine the genetic purity of the ducks. Preliminary analyses indicated that South Carolina mottled ducks generally are "pure," not revealing any significant introgression of genes from mallards or other ducks.

From left, Dr. J. Brian Davis at Clemson's Kennedy Center, Drs. Davis and Joe Lancaster at Joe's doctoral hooding at Mississippi State University, and Dr. Phil Lavretsky at the Kennedy Center.

OUTREACH

SERVICE ACTIVITIES BY THE KENNEDY CENTER

The term Outreach means communicating research and other technical knowledge from various reputable sources to public and private stakeholders, as Cooperative Extension Units are charged to do for land-grant universities and citizens of their state or nation. Land-grant universities also often term outreach as Service and provide these to the public along with Teaching and Research. Clemson University is the land-grant university of South Carolina; hence, an obvious role of the Kennedy Center is and will continue to be sharing and outreaching technical information on ecology and management of waterfowl and wetlands.

In October 2018, the Kennedy Center partnered with Nemours Wildlife Foundation, Clemson Cooperative Extension, Ducks Unlimited, Inc., and South Carolina Department of Natural Resources to convene a waterfowl and wetlands workshop. The workshop graciously was hosted by and at the Nemours Wildlife Foundation near Yesammee, SC in the ACE Basin. Over 80 participants attended to hear lectures and witness demonstrations by waterfowl and other wildlife and agricultural experts from South Carolina. The workshop agenda is shown below. Surveys of attendees indicated topics, field trips, and food satisfied all participants and new information also was gained by most attendees.

SOUTH CAROLINA ACE BASIN
WATERFOWL AND WETLAND MANAGEMENT WORKSHOP

Hosted by:

NEMOURS WILDLIFE FOUNDATION

Nemours Wildlife Foundation
161 Nemours Plantation Drive, Yemassee, SC 29945

Tuesday, 30 October 2018
In Collaboration with:

CLEMSON COOPERATIVE EXTENSION

James C. Kennedy WATERFOWL & WETLANDS CENTER

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

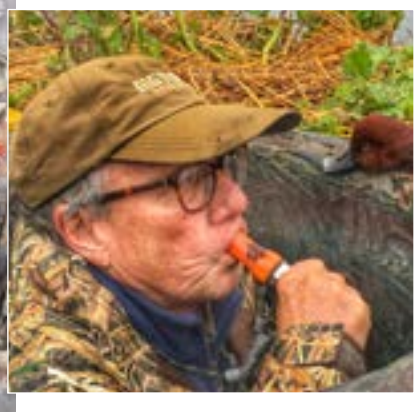
DUCKS UNLIMITED

Nemours Wildlife Foundation will host a Waterfowl Habitat Management workshop in partnership with Clemson Cooperative Extension, Clemson's James C. Kennedy Waterfowl & Wetlands Conservation Center, and South Carolina Department of Natural Resources. Information will be presented by waterfowl/wildlife, wetlands, agricultural experts on effective management practices for ACE Basin of South Carolina and other applicable fresh and brackish water landscapes.

8:00 - 8:30	Registration; coffee and donuts
8:30 - 8:35	Introduction/welcome (Dr. Ernie Wiggers, Nemours Wildlife Foundation [NWF])
8:35 - 9:00	Waterfowl in winter, habitat needs and management (Dr. Rick Kaminski, Kennedy Center [KC])
9:00 - 9:20	Ecology and management of aquatic invertebrates in brackish wetlands (Beau Bauer, NWF&KC)
9:20 - 9:40	Wood duck and whistling duck nest box use in South Carolina (Gillie Croft, NWF&KC)
9:40 - 10:00	Ecology and management of mottled ducks in the ACE Basin (Molly Kneece, SC DNR)
10:00 - 10:20	Break
10:20 - 10:40	Waterfowl abundance and whereabouts in South Carolina: Results of 2016 - 2018 aerial surveys (Nick Masto, KC)
10:40 - 11:05	New General Permit for managed impoundments and updates on the rice field mapping project; Drs. Travis Folk (Folk Land Management [FLM]) and Ernie Wiggers (NWF)
11:05 - 11:25	Managing Phragmites, white marsh, and other invasives (Jack Whetstone, Clemson Cooperative Extension and Chris Page, SC DNR)
11:25 - 11:50	Report from DNR: waterfowl regulations, statewide waterfowl outlook, multi-species management (Alicia Farrell, SC DNR)
11:50 - 12:40	Lunch (provided).
12:40 - 1:05	Waterfowl and Wetland Habitat Conservation and Easements in ACE Basin (Jamie Rader, Ducks Unlimited)
1:05 - 1:25	Southeastern Region Applied Waterfowl Research, SEAFWA Report (Ernie Wiggers, NWF)
1:25 - 1:40	Moist - soil & brackish impoundment management for waterfowl (Daniel Barrineau, SC DNR and Dean Harrigal, FLM)
1:40 - 3:30	Attendees can select to participate in 1 of 3 field trips. Maximum field trip number is 25. If first choice field trip is full, attendee will be direct to one of the other choices. Site 1: Moist - soil and brackish water impoundments, Bear Island WMA Site 2: Brackish water Impoundment management and aquatic invertebrates, Bear Island WMA Site 3: Crop field management for waterfowl on Clarendon Farms Planatation
3:30	Adjourn from the field trip site

Additionally, a collage of pictures of Dr. Ernie Wiggers, Executive Director of Nemours Wildlife Foundation welcoming workshop attendees, Nemours Wildlife Foundation mobile 'trunk' demonstration, Dr. Kaminski and former graduate students from Clemson University and Mississippi State University lecturing at the workshop, and workshop participants in the outdoor classroom and on the field trip follow. Pictures are credited to Sarah Nell Blackwell (photographer).

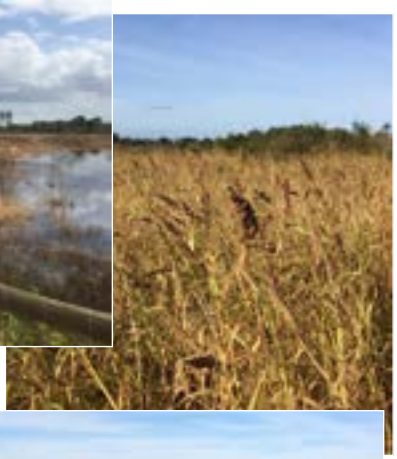
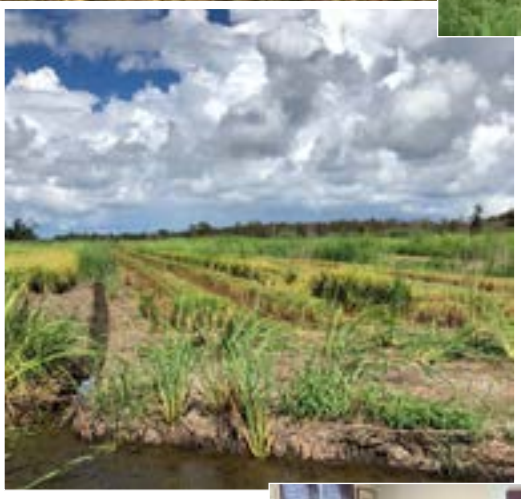
Dr. Kaminski and several other wetlands and wildlife experts conducted a workshop for South Caroliina DNR wildlife and fisheires technicians at the Santee Coastal Researve near McClellandville, SC in February 2019. Below is Bob Perrry (SC DNR retired) lecturing on fresh- and brackish wetland management for waterfowl.

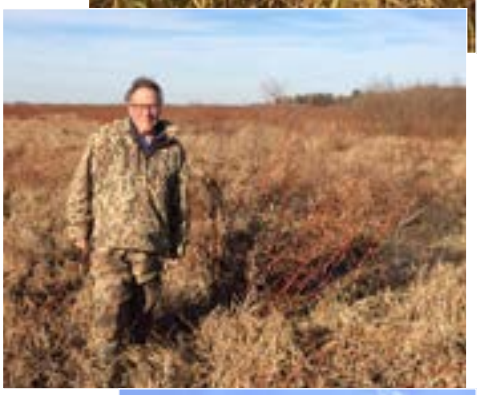


Also, Mr. Kennedy and Dr. Kaminski share emails regularly to discuss Kennedy Center activities, waterfowl habitat, and hunting issues. Far right is a picture of Mr. Kennedy and his retriever; note the Clemson orange duck call on his lanyard. I have one too. They are the easiest blowing double-reed call I've used, and they 'growl' well for divers and female pintail. Check out Big Lake Calls: https://www.biglakeoutdoorproducts.com/#!

Lastly, please enjoy the collage of pictures of numerous site visits to public and private lands and engagements made by Dr. Kaminski and students of the Kennedy Center during 2018-2019. During site visits, Dr. Kaminski advises managers or owners on waterfowl habitat management.



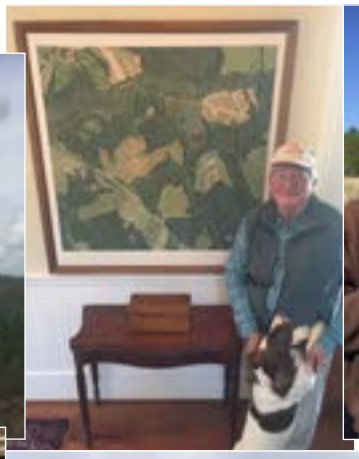
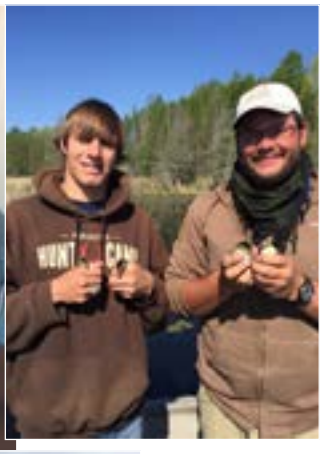






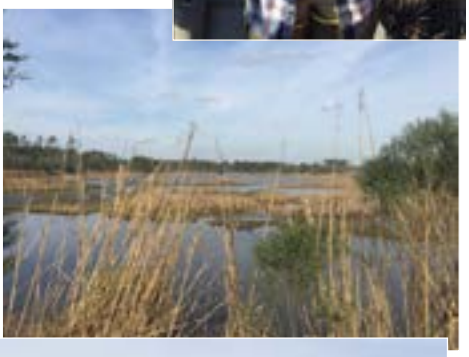








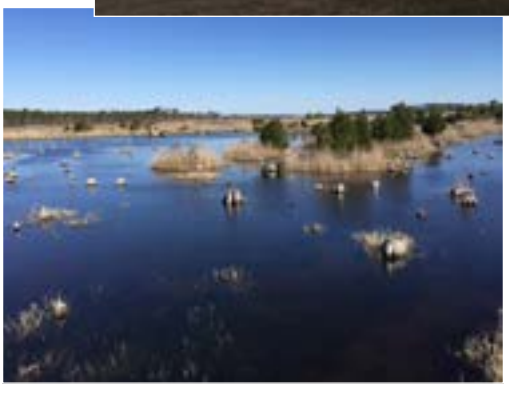








Audubon



AWARDS AND REWARDS

We are pleased to announce fellowships and other awards received by Kennedy Center-Nemours Wildlife Foundation undergraduate and graduate students during 2018-2019.

- **Beau Bauer,** former M.S. student, researching aquatic invertebrate communities in managed impoundments in coastal South Carolina. Nemours Wildlife Foundation, the Kennedy Center, and Clemson's Department of Forestry and Environmental Conservation provided support for Beau's assistantship, research, tuition, and technical assistance. Beau graduated in December 2018, with his M.S., and is employed as staff wildlife biologist for Nemours Wildlife Foundation.

- **Gillie Croft,** former M.S. student, researching wood duck and other bird use and production from nest structures across coastal South Carolina. Gillie likewise was supported as Beau Bauer. Gillie too is employed by Nemours Wildlife Foundation as a wildlife biologist.

- **Nick Masto,** Kennedy Center Master's Student Fellow, (see picture on next page) received research sponsorship from Nemours Wildlife Foundation, SC DNR, Delta Waterfowl Foundation, Ducks Unlimited, Inc., SC Waterfowl Association, and the U.S. Fish and Wildlife Service for his research on an evaluation of aerial line-transect surveys to estimate abundance and distribution of waterfowl and other waterbirds in South Carolina. Nick will graduate from Clemson in summer 2019 and then begin a doctoral program at Tennessee Tech University.

- **Lauren Senn,** Kennedy Center, Ph.D. Student Fellow (see picture on next page). Lauren and Dr. Kaminski have taught the Department's online course in Waterfowl Ecology and Management in fall semesters 2017-2019. One topic of Lauren's dissertation is a three-year evaluation of the course by surveying undergraduate and graduate students who have enrolled in it.

- **Caroline Sharpe** was the 2018-2019 academic year recipient of the James C. Kennedy Undergraduate Student Scholarship. Caroline is a Wildlife and Fisheries Biology major with a 3.62 GPA, who will graduate in December 2019. She is an active member in Clemson's Prescribed Fire Management Association ("Fire Tigers") and a Clemson Creative Inquiry (CI) intern of the Kennedy Center. She and other CI students (see picture on next page) won 2nd place for their poster among over 150 entries at the Clemson University Undergraduate Research Forum in April 2019. Their research abstract was presented previously in this report.

- **David Singletary,** (see picture on next page) May 2019 Bachelor of Science graduate in Wildlife and Fisheries Biology and Kennedy Center intern, received BOTH the Department of Forestry and Environmental Conservation and the College of Agriculture, Forestry, and Life Sciences Outstanding Senior Awards. Thank you, David, for all your contributions to earn these two most deserved awards.

Nick Masto also was honored in 2018-2019 with three awards: 1) The Douglas R. Phillips Award for Graduate Students, recognizing an outstanding graduate student exhibiting professionalism and service to Clemson University and the community ($500); 2) United Waterfowlers of Florida Graduate Research Scholarship, provided to students conducting research that benefits waterfowl hunters ($1,000); and 3) Clemson University's Natural Resources Graduate Student Association Travel Grant to present research at a conference ($225).

From left, Castles Leland, Caroline Sharpe, and Tristan Turner displaying their award winning poster.

Lauren Senn is conducting surveys to identify (1) academic and experiential credentials of professional waterfowl and wetlands ecologists and managers and (2) strategies to motivate graduate students to publish research from their thesis or dissertation in scientific journals.

David Singletary, displaying his recognition as outstanding graduating senior in Wildlife and Fisheries Biology. Love that Tiger Tie, David!

Clemson's Kennedy Center 2018-2019 Undergraduate Interns/Creative Inquiry Students:

Summer 2019 Engagements

Tristan Turner
- May 2019 graduate in Wildlife and Fisheries Biology (WFB).
- Interviewing for state and private biologist tech positions and working in family business, Greenville, SC.

David Singletary
- May 2019 graduate WFB major/Business Administration minor.
- Wildlife Manager at Fork Farm and Stables LLC, North Carolina.

Robert (Castles) Leland
- Senior (December 2019 graduation), WFB major, Nemours Wildlife Foundation and Kennedy Center intern under graduate student Amanda Williams.

Marcus (Cameron) Dudley
- Junior, WFB major, Interning at Whispering Pines Plantation, Orangeburg, SC.

Colin Farah
- Graduating senior, Environment and Natural Resources/Environmental Science minor,
- Taking summer courses.

Stephanie Braswell
- Sophomore, WFB and Animal Veterinary Science (AVS) double major/BIO minor, Camp Woodie shooting instructor and counselor.
- Nominated for 2019-2020 academic year. James C. Kennedy Waterfowl and Wetlands Conservation Center undergraduate scholarship recipient.

James Kolby Taylor
- December 2019 graduation, WFB major, Interning with SC DNR in Clemson/Pickens County.

Granger Rabon
- Junior, Forest Resources major/Urban forestry minor, Summer technician, Canfor Timber Company.

Nathan Schmidt
- Senior, WFB major/BIO minor, Interviewing/applying for graduate positions in wildlife disease ecology and animal hospital assistant, Seneca, SC.

Jonathan (JC) Tolson
- December 2019 graduation, Forest Resources major/WFB minor, taking summer courses.

Chandler Gray
- Graduating senior, WFB major, Featherhorn Farm wildlife manager intern, Summerton, SC.

Caleb Watson
- Junior, Forest Resources major/Agriculture Mechanics minor, Forestry Summer Camp.

Jordan McCall
- Sophomore, WFB major, camp counselor, Mt. Horeb Child Development Center, Chapin, SC.

Amanda Taylor
- Freshman, English major/AVS minor, Finishing Future Farmers of America state officer obligations, Tractor Supply employee, shadowing lawyers and studying for LSAT.

Caroline Sharpe
- December 2019 graduation, WFB major/Forest resource management minor, prescribed fire and management internship with SCDNR, Heritage Preserves in Pee Dee region. 2018-2019 academic year recipient of Kennedy Center undergraduate scholarship.

Jessica (Jess) Eidson
- Junior, Forest Resources major/Spanish minor, summer courses and youth shooting instructor for Richland Creek Gun Club, Saluda, SC.

Clemson University Kennedy Center Undergraduate Creative Inquiry Students at Pocosin Lakes National Wildlife Refuge, North Carolina, during spring break 2019 field trip.

KENNEDY CENTER ADVISORY COUNCIL AND ACKNOWLEDGEMENTS

The advisory council of Clemson University's James C. Kennedy Waterfowl and Wetlands Conservation Center met for its third assembly in July 2018 at Clemson's Belle W. Baruch Institute of Coastal Ecology and Forest Science near Georgetown, South Carolina. The council advises Drs. Kaminski, Van Bloem, and Yarrow and graduate students on programmatic activities and needs for the Center's advancements in teaching, research, and outreach. Current and former advisory council members, associates, and students are pictured below.

Board members represent public- and private-sector wildlife conservation professionals. Nearly 20 board members and Kennedy Center graduate students attended the 2018 meeting, which included a reception, dinner, and technical sessions, at which graduate students presented updates on their research. M.S. students included Beau Bauer, Gillie Croft, and Nick Masto, and Ph.D. student, Lauren Senn. The students research abstracts were presented previously in this report.

Matt and Molly Kaminski, family chefs, again exquisitely prepared the cuisine for the Council's dinner. We were grateful for them sharing with us their culinary skills during their and Madison's, our granddaughter, annual visit from California.

We sincerely thank board members of the Kennedy Center listed on the next page and their affiliations for their engagement and providing guidance to the Kennedy Center.

Last but never least, I sincerely thank my loving wife and partner for 50 years, Loretta, for all she has done and continues to do for our family, students, friends, and me. Her 'behind-the-scenes' contributions have greatly enabled Team Duck's successes for waterfowl and wetlands science and conservation over the decades. Thank you, Mama Duck, as you are affectionately known. Moreover, I thank our children, Matt and Shannon, their respective spouses, Molly and Neil, and our darling, healthy, bright grandchildren, Madison Kaminski, Tanner and Penelope Mayberry, for loving of us and creating reasons to live long.

- **Jason Ayers,** South Carolina Coastal Program Coordinator, U.S. Fish and Wildlife Service;
- **Billy Dukes,** Chief of Wildlife, South Carolina Department of Natural Resources (SCDNR);
- **Jim Clark,** manager, Weehaw Plantation;
- **Jamie Dozier,** Project Leader, Tom Yawkey Wildlife Center, SCDNR;
- **Travis H. Folk,** woodland and wildlife consultant, Folk Land Management, Inc., Green Pond, SC;
- **Jason Hewett,** Manager, Clarendon Farms;
- **Beth Ross;** Assistant Leader, South Carolina Cooperative Fish & Wildlife Research Unit; Clemson University;
- **Thomas Rainwater,** Wildlife Research Scientist, Yawkey Wildlife Foundation and Belle W. Baruch Institute of Coastal Ecology and Forest Science;
- **Sharon Richardson,** South Carolina Audubon Society;
- **Buford Mabry,** Delta Waterfowl Foundation;
- **Bill Mace,** Manager, Annandale Plantation;
- **Robert Perry,** Palmetto Natural Resources Management, LLC
- **Michael Prevost,** wildlife biologist and land manager, White Oak Forestry and Rochelle Plantation;
- **Jamie Rader,** Director of Conservation – Southeast; Ducks Unlimited; Southern Region; South Atlantic Field Office;
- **Skip Van Bloem,** Director, Baruch Institute of Coastal Ecology and Forest Science;
- **Craig Watson,** South Atlantic Coordinator, U.S. Fish and Wildlife Service, Charleston Ecological Services Field Office;
- **David Wielicki,** Executive Director, South Carolina Waterfowl Association;
- **Ernie Wiggers,** CEO Nemours Wildlife Foundation;
- **R. Kenneth Williams,** Owner, Williams Land Management Company;
- **Greg Yarrow,** Professor and Chair, Clemson's Department of Forestry and Environmental Conservation

The Kaminski and Mayberry families

Completed or Current Journal Articles/Abstracts (*n* =16)

Croft, G. D. 2018. Reproduction and nest-box selection by wood ducks and black-bellied whistling ducks in coastal South Carolina. Thesis, Clemson University, December 2018.

Croft, G. D., R. M. Kaminski, E. P. Wiggers, P. D. Gerard, and G. K. Yarrow. 2019. Nest box use by wood ducks and black-bellied whistling ducks in coastal South Carolina. Wildlife Society Bulletin, in review.

Bauer, B. A. 2018. Effects of hydrological management for submersed aquatic vegetation biomass and invertebrate biomass and diversity in South Carolina coastal impoundments. Thesis, Clemson University, December 2018.

Bauer, B. A., R. M. Kaminski, J. D. Lanham, P. D. Gerard, and E. P. Wiggers. 2019. Hydrological management and submersed aquatic vegetation biomass in South Carolina coastal impoundments. Wildlife Society Bulletin, in revision.

Kaminski, R.M. et al. 2019. 21st Century Waterfowl, Waterbird, and Wetland Science and Conservation in Southeastern United States, accepted abstract, 2019 SEAFWA Special Session, Hilton Head, SC, October 2019.

Hepp, G. et al. 2019. Ecology and conservation of wood and other cavity nesting ducks. Accepted abstract for special session at 8th North American Duck Symposium, Winnipeg, Manitoba, CANADA, August 2019.

Marty, J., J.B. Davis, R.M. Kaminski, M. G. Brasher, and S. Rush. 2019. Rice and natural seed abundances in Gulf Coast prairie croplands: Biomass estimates for avian habitat conservation. Ecosphere, in review.

Lancaster, J., J.B. Davis, R.M. Kaminski, and G. Street. 2019. Habitat use by female mallards during and after waterfowl hunting seasons in Mississippi. Journal of Wildlife Management, in review.

Lancaster, J.D., S.E. McClain, M.C. Gross, C.N. Jaques, N.M. Masto, R.M. Kaminski, and H.M. Hagy. 2019. Assessment of excreta collection methods to estimate true metabolizable energy of waterfowl foods in wild ducks. Wildlife Society Bulletin, in press.

Straub, J. N., A. G. Leach, R. M. Kaminski, A. W. Ezell, and T. D. Leininger. 2019. Red oak acorn yields in green-tree reservoirs and non-impounded forests in Mississippi. Wildlife Society Bulletin, in press.

Monroe, K., A. Monroe, J. B. Davis, R. M. Kaminski, M. J. Gray, and D. Evans. 2019. Habitat selection and management of wintering American black ducks in Tennessee. Wildlife Society Bulletin, in revision.

Masto, N. M. and G. D. Croft. 2018. Follow that duck! Clemson students migrate to deepen their waterfowl knowledge. The Wildlife Professional Winter (Nov-Dec) 2018:39-43.

Masto, N. M. et al. 2018. Aerial-strip transect surveys to estimate fall-winter abundance and distribution of waterfowl and other waterbirds in South Carolina. Annual Report, James C. Kennedy Waterfowl and Wetlands Conservation Center, Clemson University. (pdf copies available from nmasto@g.clemson.edu).

Post, C. J., M. P. Cope, P. D. Gerard, N. M. Masto, J. Vine, R. Y. Stiglitz, E. A. Mikhailova. 2018. Monitoring spatial and temporal variation of dissolved oxygen and water temperature in the Savannah River using a sensor network. Journal of Environmental Monitoring and Assessment 190:272.

Schmidt, N., R. Leland, N. Masto, and R. Kaminski. 2019. Clemson Tigers' Waterfowl and Wetlands Spring Migration. Spring Newsletter, Southeastern Section of The Wildlife Society.

Schmidt, P., R.M. Kaminski, and E.P. Wiggers. 2018. Call to action: Identifying priority research questions for the southern Atlantic Flyway. Available from E. P. Wiggers, Nemours Wildlife Foundation, ewiggers@nemourswildlife.org.

Oral and Poster Presentations (*n* = 35)

Sharpe, C., J. Eidson, R. C. Leland, T. Turner, C. Farah, S. Braswell, C. Watson, J. C. Tolson, R. Coen, B. Bauer, N. M. Masto, R. M. Kaminski. 2019. A rake sampling method to estimate biomass of submersed aquatic vegetation for waterfowl in managed South Carolina coastal wetlands. 2nd Place Overall Poster, 14th Annual Focus on Creative Inquiry Forum, Clemson, SC. 2 Apr 2019.

Singletary, D., N. Schmidt, A. Taylor, J. McCall, G. Rabon, M. Dudley, C. Gray, G. C. Croft, N. M. Masto, R. M. Kaminski. 2019. Wood duck (Aix sponsa) use of and reproduction in artificial nest boxes: Clemson University undergraduate research in Piedmont South Carolina. Poster, 14th Annual Focus on Creative Inquiry Forum, Clemson, SC. 2 Apr 2019.

Kaminski, R.M. 2019. Winter waterfowl needs fulfilled from wetland complexes. Invited lecture to Dr. Wm. Conner's Wetlands Ecology class, Clemson University, Baruch Institute. 21 March 2019.

Kaminski, R.M. 2019. In field lectures on waterfowl and wetlands ecology and management. Spring break field trip to North Carolina waterfowl management refuges and areas. 16-19 March 2019.

Kaminski, R.M. 2019. Waterfowl in winter: Ducks' needs met by habitat complexes. Invited lecture, South Carolina Department of Natural Resources, Santee Coastal Reserve WMA, Charleston, SC, 20 February 2019.

Senn, L. H.R. (2018) Converting In-Person Courses into an Online Format. Presented at Clemson Teaching Forum, Clemson University, Clemson, SC, 17 December 2018.

Masto, N. M., M. R. Kneece, R. M. Kaminski, B. E. Ross, K. Barrett, and P. Gerard. 2018. Aerial surveys for fall-winter waterfowl and waterbirds in South Carolina. Invited presentation to inaugural forum of university endowed waterfowl and wetlands programs' faculty and graduate students. Paul Bonderson's Bird Haven Ranch, Willows, CA, 10-12 December 2018.

Kaminski, R.M. 2018. University waterfowl and wetlands programs: past, present, and a brightening future. Invited presentation to inaugural forum of university endowed waterfowl and wetlands programs' faculty and graduate students. Paul Bonderson's Bird Haven Ranch, Willows, CA, 10-12 December 2018.

Senn, L. H.R., R. M. Kaminski, S. Rodriguez, A. Hagan, D. Hitchcock, and W. Conner. (2018) Development, Delivery, and Assessment of an Online University Course in Waterfowl Ecology and Management. Presented at The South Carolina Chapter of The Wildlife Society Annual Meeting, Clemson, SC, 26-27 November 2018.

Masto, N. M., M. R. Kneece, R. M. Kaminski, B.E. Ross, K. Barrett, and P. Gerard. Abundance and whereabouts of waterfowl and waterbirds in South Carolina: aerial transect survey project update. Clemson University and South Carolina Department of Natural Resources Cooperative Programs Meeting, Kresge Outdoor Lab, Clemson, SC. 7 November 2018.

Kaminski, R.M. 2018. Who will mind the marsh? Keynote address to Indigo Society of Georgetown, SC, 2 November 2018.

Kaminski, R.M. 2018. Waterfowl in winter, habitat needs and management. South Carolina ACE Basin Waterfowl and Wetlands Management Workshop, Nemours Wildlife Foundation, Yemassee, SC. 30 October 2018.

Bauer, B., R.M. Kaminski, and E.W. Wiggers. 2018. Ecology and management of aquatic invertebrates in brackish wetlands. South Carolina ACE Basin Waterfowl and Wetlands Management Workshop, Nemours Wildlife Foundation, Yemassee, SC. 30 October 2018.

Croft, G., R.M. Kaminski, E.W. Wiggers, P.D. Gerard, and G. Yarrow. 2018. Wood duck and black-bellied whistling duck nest box use in South Carolina. South Carolina ACE Basin Waterfowl and Wetlands Management Workshop, Nemours Wildlife Foundation, Yemassee, SC. 30 October 2018.

Kneece, M., C. Shipes, J.B. Davis, E.W. Wiggers, and R.M. Kaminski. 2018. Ecology and management of mottled ducks in ACE Basin, South Carolina. South Carolina ACE Basin Waterfowl and Wetlands Management Workshop, Nemours Wildlife Foundation, Yemassee, SC. 30 October 2018.

Kneece, M., N. Masto, R.M. Kaminski, B. Ross, K. Barrett, P. Gerard, and A. Pearse. 2018. Waterfowl and waterbird abundance and whereabouts in South Carolina. South Carolina ACE Basin Waterfowl and Wetlands Management Workshop, Nemours Wildlife Foundation, Yemassee, SC. 30 October 2018.

Schummer, M.L., A.M. Smith, R.M. Kaminski, K.M. Hunt, E. St. James, and H. Havens. Achievement-oriented effects of waterfowl-hunt quality at Mississippi Wildlife Management Areas. SEAFWA, Mobile, AL. 23 October 2018

Kaminski, R.M. 2018. The James C. Kennedy Waterfowl and Wetlands Conservation Center, Clemson University. Mentor-Mentee luncheon, SEAFWA, Mobile, AL, 22 October 2018.

Schmidt, P., E. W. Wiggers, and R.M. Kaminski. 2018. Evaluating wood duck nest boxes and advancing recruitment. Science and management needs for cavity nesting ducks in the southern USA Symposium, SEAFWA, Mobile, AL. 22 October 2018.

Davis, A.D., J.B. Davis, R.M. Kaminski, and S.E. Stephens. 2018. Use of nest boxes by wood ducks and hooded mergansers at Noxubee and Yazoo National Wildlife Refuges, Mississippi. Science and management needs for cavity nesting ducks in the southern USA Symposium, SEAFWA, Mobile, AL. 22 October 2018.

Davis, J.B., and R.M. Kaminski. 2018. Ecology and management of wood duck ducklings and broods produced in nest boxes. Science and management needs for cavity nesting ducks in the southern USA Symposium, SEAFWA, Mobile, AL. 22 October 2018.

Croft, G. C., R. M. Kaminski, E. W. Wiggers, P. D. Gerard, and G. K. Yarrow. 2018. Nesting duck use, production, and selection of nest structures in coastal South Carolina. Symposium: Science and management needs for cavity-nesting ducks in southern United States. SEAFWA Conference, Mobile, Al, 22 October 2018.

Croft, G. C., R. M. Kaminski, E. W. Wiggers, P. D. Gerard, and G. K. Yarrow. 2018. Reproduction, nest-box selection and satellite tracking of black-bellied whistling ducks in coastal South Carolina. Symposium: Science and management needs for cavity-nesting ducks in southern United States. SEAFWA Conference, Mobile, Al, 22 October 2018.

Hepp, G. R., and R. M. Kaminski. Co-organizers. Science and management needs for cavity-nesting ducks in southern United States: A symposium. 2018 SEAFWA Conference, 22 October, Mobile, AL.

Kaminski, R.M., E.W. Wiggers, and P. Schmidt. 2018. Tackling waterfowl research and management questions at a regional scale. Invited presentation to SEAFWA Wetlands Wildlife Subcommittee, 21 October, Mobile, AL.

Bauer, B. 2018. Influence of hydrological management for widgeongrass (Ruppia maritima) on widgeongrass and other submersed aquatic vegetation biomass in South Carolina coastal impoundments. Invited presentation, Belle W. Baruch Institute of Coastal Ecology and Forest Science, Georgetown, SC, 9 October 2018.

Kaminski, R.M. 2018. Moist-soil habitat ecology and management recommendations for Shiawassee Waterfowl Management Area and National Wildlife Refuge, St. Charles, Michigan. Invited keynote lecture and workshop. 11-12 September 2018.

Croft, G. D. 2018. Reproduction and nest-box selection by wood ducks and black-bellied whistling ducks in coastal South Carolina. M.S. thesis defense public seminar, Clemson University, Clemson, South Carolina, 7 September 2018.

Kaminski, R. M, and E. Wiggers. 2018. University-based waterfowl and wetlands programs: Past, present, and bright future. Invited presentation to South Carolina Plantation Managers' Annual Meeting, Brosman Forest, St. George, SC, 9 August 2018.

Bauer B.A., R.M. Kaminski, J.D. Lanham, P.D. Gerard, E.P. Wiggers, and C.P. Marsh. 2018. Wetland Management for Widgeongrass and Aquatic Invertebrate Biomass in South Carolina Tidal Coastal Impoundments. Presentation to Kennedy Center Advisory Council, Baruch Institute, 25 July 2018.

Masto, N. M., M. R. Kneece, R. M. Kaminski, B. E. Ross, K. Barrett, and P. Gerard. 2018. Aerial strip-transect surveys to estimate abundance and distribution of wintering waterfowl and other waterbirds in South Carolina. Presentation to Kennedy Center Advisory Council, Baruch Institute, Georgetown, South Carolina, 25 July 2018.

Senn, L. H.R., and R.M. Kaminski (2018) Development, Delivery, and Assessment of an Online University Course in Waterfowl Ecology and Management. Presentation to Kennedy Center Advisory Council, Baruch Institute, Georgetown, SC, 25 July 2018.

Croft, G. D., E. P. Wiggers, R. M. Kaminski, P. D. Gerard, and G. K. Yarrow. 2018. Use, production, and selection of nest boxes by wood ducks and black-bellied whistling ducks in coastal South Carolina. Presentation to Kennedy Center Advisory Council, Baruch Institute, 25 July 2018.

Croft, G. D., E. P. Wiggers, R. M. Kaminski, P. D. Gerard, and G. K. Yarrow. 2018. Use, production, and selection of nest boxes by wood ducks and black-bellied whistling ducks in coastal South Carolina. Invited presentation to South Carolina Wildlife Federation, Columbia SC, 16 July 2018.

Croft. G.D., R.M. Kaminski, E.P. Wiggers, P.D. Gerard, and G.K. Yarrow. 2018. Lowcountry survey of box nesting ducks and management recommendation. Oral presentation, DeBordieu Environmental Forum. Georgetown, S.C.