HEALTHY COASTAL ECOSYSTEMS

ACCOMPLISHMENT

S.C. Sea Grant Consortium Hosts Inaugural State-Wide Research Symposium

Brita Jessen, Louis Heyward, and Susan Lovelace, S.C. Sea Grant Consortium

RECAP: The first S.C. Sea Grant Consortium (Consortium) Research Symposium was hosted in May 2022 at The Citadel with the theme *Science* + *Inclusion* = *Solutions* to generate new interdisciplinary connections and partnerships, share research outcomes, and provide training for students and researchers to build trust and work more closely with historically underserved and underrepresented communities.

RELEVANCE: The Consortium staff recognized a need to create a community of researchers and students funded by the Consortium. Additionally, following two years of reduced in-person meetings due to COVID-19, the local research community has lacked opportunities to regather and create opportunities for partnerships and connections. Finally, with an eye on the increasing importance of diversity, equity, and inclusion (DEI) in Consortium-funded research, ongoing DEI-related training for all SC students and researchers is necessary.

RESPONSE: The S.C. Sea Grant Consortium Research Symposium convened 115 researchers and students at The Citadel in May 2022 to share research; attract new partnerships; provide training to incorporate DEI in all aspects of research; and develop closer partnerships with stakeholders. Due to a positive response by attendees, the Consortium will continue the symposia (every-other year frequency) to provide opportunities for all researchers to share ideas, foster partnerships, receive training, and build a community identity.

RESULTS: Students and researchers gathered as a state-wide community for the first time to exchange Consortium-funded research and receive training on the incorporation of DEI for research teams and stakeholder engagement. All members were invited to participate in facilitated breakout discussions focused on water quality, aquiculture, green infrastructure, resilience, restoration, and public health. Information gained at these sessions informed Consortium staff on the agency's research and strategic plan priorities.

PARTNERS: S.C. Sea Grant Consortium (staff and partners)

S.C. Sea Grant Consortium Builds Partnerships to Compete for Marine Debris Funding Opportunities

Susan Lovelace, Matt Gorstein, Brooke R. Saari, Brita Jessen, and Sarah Pedigo, S.C. Sea Grant Consortium

Katie Finegan, S.C. Sea Grant Consortium and Coastal Carolina University

RECAP: The S.C. Sea Grant Consortium leads the submission of seven marine debris proposals (four Marine Debris Challenge and three Community Action Coalition) through significant contributions from several staff.

RELEVANCE: There are many types, sources, and causes of marine debris, which has long been a significant issue and includes plastic waste, trash, derelict vessels and fishing gear, and microplastics. To strengthen efforts in

prevention and mitigation, the Infrastructure Investment and Jobs Act (IIJA), has directed NOAA's National Sea Grant College Program to execute $50 million over five years for the prevention and removal of marine debris.

RESPONSE: To address issues related to marine debris in South Carolina and the South Atlantic Region, the Consortium worked to build four research teams and three community action coalitions to compete for these funding opportunities. All of the proposals had diversity, equity, and inclusion principles woven throughout—from partners to students, and from capacity building to allocation of funding resources.

PARTNERS: University of South Carolina, Clemson University, College of Charleston, Gullah/Geechee Sea Islands Coalition, Gullah Geechee Chamber of Commerce, Gullah Preservation Society, Robinson Design Engineers, South Carolina Aquarium, Murrells Inlet 2020

S.C. Sea Grant Consortium Renovates and Enhances SC Water Quality Monitoring Portal

Brooke R. Saari, S.C. Sea Grant Consortium
Landon Knapp, S.C. Sea Grant Consortium and College of Charleston
Norman Levine, College of Charleston
Duncan Williamson, College of Charleston (Graduate Student) and S.C. Sea Grant Consortium

RECAP: The S.C. Sea Grant Consortium (Consortium) led the renovation and enhancement of the 2015 the South Carolina water monitoring network portal to meet the updated data and visualization needs of stakeholders using funding for a dedicated student to focus on targeted improvements and expansion.

RELEVANCE: The 2015 South Carolina water monitoring network portal was a tool created following Hurricane Joaquin associated flooding. The tool aimed to coordinate/capture where water quality samples were being taken, what organization was sampling, and what was being tested. Over the following years, the tool was not maintained and could not be utilized properly. Through preliminary discussions with the Coastal Environmental Quality (CEQ) advisory board, it was determined that this tool should be renovated.

RESPONSE: Funding was realized and a student was hired. To kick off the project, a workshop was convened with invited stakeholders to discuss needs and uses. A summary document was created to guide discussions (internally) on what could and could not be accomplished. A list of voluntary beta testers was compiled and utilized for review of the tool review.

RESULTS: The new tool is in the final development stage with an estimated completion date of summer 2023. Beta testing feedback and updates were gathered throughout late 2022 and early 2023. The final tool will have a completed user direction story map and video (updated per beta tester feedback). Final outreach materials and long-term maintenance plans will be implemented by completion date.

S.C. Sea Grant Consortium Participated in the Coordination of the Grand Strand Healthy Pond Series

Brooke R. Saari, S.C. Sea Grant Consortium
Maeve Snyder, North Inlet-Winyah Bay National Estuarine Research Reserve
C. Guinn Wallover, Mount Pleasant Water Works (formerly of Clemson Cooperative Extension)

RECAP: The S.C. Sea Grant Consortium (Consortium) staff contributed to the design, implementation, and facilitation of a program series focused on pond owners and homeowners associations in coastal South Carolina.

RELEVANCE: In South Carolina, stormwater ponds are the most common structural best management practice for regulating stormwater runoff, particularly in coastal areas where development rates are high. Despite their benefits, they create a unique set of management issues without proper maintenance. Some of the most common barriers to pond maintenance include lack of awareness of responsibility, misinformation on best management techniques, and financial costs.

RESPONSE: The Consortium (along with partners) organized and implemented a regional pond education series called the Healthy Pond Series. The series was tailored to the regions within the coastal zone, in mostly virtual format. Two interactive programs focused on extending the latest stormwater pond scientific information, resources, guidance, and tools to pond managers and owners. The goal of these webinars was to create an opportunity for pond owners to learn and share pond management techniques.

RESULTS: These webinars educated 30 participants about the topics of aeration and plastic pollution in stormwater ponds. Participants included multiple government-level sectors, homeowners associations, academia, and private sector. A post-event survey (50% response rate) revealed that respondents increased knowledge (100%) and indicated they learned something new (73%). Overall, participant feedback revealed that attending these events was a good use of their time (100%) and indicated excitement over upcoming opportunities.

Consortium's *State of Knowledge Report on Stormwater Ponds* Continues Be Valued Resource in South Carolina

Brooke R. Saari, S.C. Sea Grant Consortium

RECAP: Since publication, the *State of the Knowledge Report on Stormwater Ponds* continues to be a used and valued resource for South Carolina.

RELEVANCE: More than 9,000 residential stormwater ponds in the eight coastal counties of South Carolina are providing numerous benefits (including control of stormwater runoff and improvement of water quality). In order to maintain and enhance the functionality of the stormwater ponds, we need to ensure that our coastal residents, stormwater managers, and researchers have access to the most relevant information, tools, and resources needed to make sound management decisions, communicate their efforts, and inform sustainable behaviors.

RESPONSE: The S.C. Sea Grant Consortium coordinated the effort to develop the state of knowledge (SOK) report on stormwater ponds in South Carolina, published in 2019. Since publication, the SOK report and the executive summary serve as outreach products to improve public knowledge regarding stormwater ponds.

RESULTS: The executive summary was provided to various audiences since publication, with more than 300 copies distributed and 118 copies downloaded (39 downloads this past year). The SOK report has been accessed 669 times and the PDF was downloaded 261 times (72 in the past year). These products have been used by other extension and outreach organizations such as Clemson Extension and the Ashley Cooper Stormwater Education Consortium.

S.C. Sea Grant Consortium Implements Water Chats—A Water Quality Technical Training Program

Brooke R. Saari and Matthew Gorstein, S.C. Sea Grant Consortium
C. Guinn Wallover, Mount Pleasant Water Works (formerly of Clemson Cooperative Extension)
Amy Scaroni, Clemson University
Heather Nix, Clemson Cooperative Extension

RECAP: Water Chats is a water quality technical training program designed to connect natural resource professionals and decision-makers with the latest water quality research in the state to inform management decisions.

RELEVANCE: Water has defined South Carolina through settlements, culture, tourism, drinking water, recreation, food, and habitats. Natural resource managers depend on research to inform their decision making. However, obtaining applicable research can be an issue with a disconnect between resource managers and researchers. Water Chats was created to deliver timely water quality information to natural resource managers in South Carolina.

RESPONSE: Through input from the Water Chats advisory council, eight webinars were convened (focusing on research and application in four theme focus areas: contaminants of concern, harmful algal blooms, stormwater control measures, and source water protection). Presenters included 21 research and management professionals as well as 10 graduate student researchers, from f5 different universities, chosen through a call for abstract submissions process.

RESULTS: Over 470 attendees from approximately 90 organizations representing program target audiences (technical managers, natural resource managers, regulatory staff, decision makers, engineers, outreach professionals, and researchers) were in attendance throughout the eight free webinars. Evaluation data showed 95% of respondents (n=66) gained new knowledge and 74% plan to apply that knowledge to their work, with 92% overall found the webinars a good use of time. Target audience attendees indicated topics were timely and applicable.

South Carolina Water Chats: Delivering Research to Those Who Need It

Brooke R. Saari, S.C. Sea Grant Consortium
Amy Scaroni, Clemson University
C. Guinn Wallover, Mount Pleasant Water Works (formerly of Clemson Cooperative Extension)

RECAP: As part of the Water Chats program, the S.C. Sea Grant Consortium (Consortium) is coordinating the publication of a special issue of the *Journal of South Carolina Water Resources* to supplement efforts to better connect researchers and natural resource managers in the state.

RELEVANCE: Water has defined South Carolina through settlements, culture, tourism, drinking water, recreation, food, and habitats. Natural resource managers depend on research to inform their decision making. However, obtaining applicable research can be an issue with a disconnect between resource managers and researchers. Water Chats was created to deliver timely water quality information to natural resource managers through virtual webinars and publications.

RESPONSE: As another outlet for Water Chats content in addition to the webinars, the Consortium coordinated the development of a Water Chats-focused special issue of the *Journal of South Carolina Water Resources*. This open-access journal issue will provide an opportunity for students, early career scientists, outreach professionals, and researchers to publish their work in an accessible format and will feature both research articles and communication

pieces.

RESULTS: A guest editor team of partners across state agencies, universities, and NGOs was convened to review articles focused on applied water quality research in South Carolina. Eleven letters of intent for articles have been received and are in the latter stages of review. The special issue will be published in 2023.

Building a Regional Network to Study the Influence of Climate Change on Contaminants of Emerging Concern

Brooke R. Saari, S.C. Sea Grant Consortium
Katy Smith, University of Georgia Marine Extension and Georgia Sea Grant
Cathy Janasie, National Sea Grant Law Center
Hailey Connell, College of Charleston (Graduate Student)

RECAP: S.C Sea Grant Consortium (Consortium) staff convened a group of partners to conceptualize, write, and submit for grant funding to build a contaminants of emerging concern (CEC) program and network in the Southeast.

RELEVANCE: Interactions of increased pollution and extreme climate variation has put pressure on water quality in the Southeast, lending a need for future research to address contaminant and climate hazards on human and ecosystem health. CECs pose potential threats that are understudied especially as it relates to their reactions to various climate drivers.

RESPONSE: Consortium staff convened a group of partners to conceptualize a contaminants of emerging concern (CEC) program and network in the Southeast that focuses on impacts of climate change. The work group included Sea Grant partners from Georgia and the Sea Grant Law Center. Advisors from federal and state government informed the writing of a proposal to build the program.

RESULTS: The project team was funded $411,148 to convene the project, including conceptualizing and releasing a Southeast-focused request of proposals. With funding acquired, the project kicked off with a graduate student hiring search. To allow prioritization of research needs, the student is conducting a literature review and gap analysis to identify research needs and focus. The project team next steps include convening an advisory committee of experts with diverse perspectives to determine what issues of CECs and climate to address for requests for proposals to be released in late 2023.

Charleston Area Stormwater Pond Management Conference Co-organized by S.C. Sea Grant Consortium

Brooke R. Saari and April Turner, S.C. Sea Grant Consortium
Beatriss Calhoun and Samantha Porzelt, Clemson Extension
C. Guinn Wallover, Mount Pleasant Water Works (formerly of Clemson Cooperative Extension)
Abigail Locatis Prochaska and Sean Cannon, A.C.E. Basin National Estuarine Research Reserve

RECAP: The S.C. Sea Grant Consortium (Consortium) co-organized the pond management conference that provided training and technical assistance to 75 stormwater professionals, homeowners, academics, and local government officials and staff in the greater Charleston area.

RELEVANCE: In South Carolina, stormwater ponds are the most common structural best management practice for

regulating stormwater runoff, particularly in coastal areas where development rates are high. Despite their benefits, they create a unique set of management issues without proper maintenance. Some of the most common barriers to pond maintenance include lack of awareness of responsibility, misinformation on best management techniques, and financial costs.

RESPONSE: The Consortium (and partners) organized a regional pond conference on April 28, 2022, extending the latest stormwater pond scientific information, resources, and tools to public and private sector pond managers and owners. Goals of this event were to increase awareness of pond purpose and need for regular maintenance; provide information and tools to overcome common pond management challenges; and integrate pond owners and managers with service providers to assist in inspections and management actions.

RESULTS: Seventy-five participants (including property managers, homeowners' association representatives, and pond management professionals) attended the conference. Fourteen participants received up to five continuing education unit credits. The project team was able to successfully bring together participants into a long awaited in-person conference after years of virtual formats.

Second Year of Flooding 411–Residential Focused Flooding Education Program Provided for Coastal South Carolina

Brooke R. Saari and Emmi Palenbaum, S.C. Sea Grant Consortium
Katie Finegan, S.C. Sea Grant Consortium and Coastal Carolina University
Ellen Sturup Comeau, Beatriss Calhoun, and Kim Morganello, Clemson Cooperative Extension
C. Guinn Wallover, Mount Pleasant Water Works (formerly of Clemson Cooperative Extension)
Maeve Snyder, USC-North Inlet-Winyah Bay NERR
Abigail Locatis Prochaska, S.C. Department of Natural Resources and A.C.E. Basin NERR

RECAP: The S.C. Sea Grant Consortium (Consortium) assisted with year two of the Flooding 411 program, which consisted of a summer series of four 90-minute virtual educational webinars that were provided to coastal South Carolina residents to help them learn how to address various flooding issues they experience. There was also a separate complimentary webinar series of "Ask an Expert" hours.

RELEVANCE: Approximately 27% of South Carolina's population lives in a coastal area (which is prone to flooding). Many residents in the coastal zone have indicated on various program evaluations the need for more information on how flooding impacts them, what to expect, how to prepare, and how to respond. As flooding impacts are projected to increase with climate change and sea levels, it is important to continue providing residents with information on flooding and mitigation actions.

RESPONSE: The Consortium and partners used Flooding 411 program (previous-year) evaluations along with informal MS4 needs assessments to plan the summer series to meet stakeholder needs. Four 90-minute webinars addressed flooding issues concerning coastal SC residents. The "Ask an Expert" hour focused on understanding flood insurance. The Consortium assisted in coordinating speakers, providing content for sessions, and moderating. Various scientific and government experts delivered information on flooding safety, property protection, community impacts, and who to contact.

RESULTS: The four webinars offered in June 2022 were titled: "Water in Our Landscape: Constant Change," "Who's Who for Flood Management and Recovery," "Reducing Flood Impacts to Your Property and Community," and

"Successful Community Flood Management." The Consortium worked on two of the webinars, developed the website, and produced all advertisement flyers for the series and individual webinars. Participants (~61 attending) were overall favorable of the series and content with praise being for the residential focus.

Trawl to Trash: S.C. Sea Grant Consortium Supporting Shrimpers and Removing Marine Debris

Brooke R. Saari, Sarah Pedigo, and Matt Gorstein, S.C. Sea Grant Consortium
Dodie Sanders, Bryan Fluech, Katie Higgins, and Todd Recicar, University of Georgia Marine Extension and Georgia Sea Grant
Victoria Smalls, Gullah Geechee Cultural Heritage Corridor

RECAP: The S.C. Sea Grant Consortium (Consortium) builds outreach components of the Trawl2Trash program in South Carolina and convenes and leads a team to request funds from the NOAA Marine Debris Community award to expand the Trawl2Trash program. This program was originally developed by Georgia Sea Grant and expanded to the Consortium in 2021 to help commercial shrimpers in GA and SC earn money during the offseason by upcycling shrimp trawl nets into stow bags.

RELEVANCE: Heavily worn trawl nets that are no longer fishable become burdens to fishermen. If disposed of improperly, they can become "ghost fishing gear" or take up property space. Additionally, many shrimpers go months in the offseason without earning income. In creating a product from these used nets, shrimpers can earn extra income while nets are repurposed. Resulting stow bags are distributed through community outreach and stewardship efforts to prevent and collect litter from coastal waterways.

RESPONSE: Education and extension specialists with the Consortium and University of Georgia Marine Extension and Georgia Sea Grant developed a NOAA Marine Debris proposal for expansion of the Trawl2Trash program.

RESULTS: In South Carolina, rack cards were developed to provide information on bag use and program purpose. Consortium staff distributed stow bags to volunteers cleaning up litter in waterways, partners, and the public so they could collect and dispose of marine debris.

S.C. Sea Grant Consortium Researchers Study Impacts of Microplastic and Tire-Wear Particles in Coastal Waterways

Peter van den Hurk, Clemson University
John Weinstein, Citadel
Barbara Beckingham, College of Charleston

RECAP: The S.C. Sea Grant Consortium (Consortium) researchers found microplastic particle accumulation in shrimp and stormwater treatment devices.

RELEVANCE: Marine plastic debris is considered a top environmental problem and an emerging global issue that might affect our ability to conserve biological diversity and maintain ecological interrelationships. In 2014, a comprehensive survey of the occurrence of microplastic particles in Charleston Harbor was conducted, and the most common type found was black fragments from tire-wear particles produced through the abrasion of tires on road surfaces.

RESPONSE: Consortium researchers are characterizing the cumulative effects of microplastics (including tire particles, with their associated toxic chemicals on keystone estuarine organisms in stormwater detention ponds and salt marsh-tidal creek systems). Sediment samples collected on streets, within stormsewer catch basins, and at the stormsewer discharge point to their adjacent tidal creeks were analyzed for tire road wear particles and other microplastics.

RESULTS: Researchers analyzed the effectiveness of using the hot needle method of identifying microplastics, and found it to be >90% effective in identifying them in field samples. An improved method to isolate and identify tire road wear particles from soil/sediment matrix was also developed and described. Tire road wear particles (TWRPs) and other microplastics were present at every sample site, with TWRPs being the most dominant. Finally, significant delays in maturation of shrimp were found in samples that consumed microplastics versus the control of pluff mud.

PARTNERS: Mount Pleasant Stormwater, CrystalStream Technologies

S.C. Sea Grant Consortium Contributes to Blue Carbon Roundtable and Research

Brita Jessen and Susan Lovelace, S.C. Sea Grant Consortium

RECAP: In Atlanta, the S.C. Sea Grant Consortium (Consortium) and partners—including Georgia Sea Grant and U.S. Geological Survey (USGS)—contributed to a roundtable discussion and a subsequent grant proposal to educate multiple sectors (including private finance, resource managers, scientists, and community leaders) on the opportunities and information needs to support public-private partnerships that enhance coastal wetland conservation and resilience using carbon storage, often called blue carbon.

RELEVANCE: Promoting the storage of coastal blue carbon in coastal wetlands (e.g., salt marsh, seagrass, mangroves) is an emerging strategy to support long-term conservation, restoration, and sustainable management. Decision-makers from diverse sectors (e.g., private land owners, investors) are interested in blue carbon as an incentive to invest in coastal habitat conservation and rehabilitation. However, more research and cross-sector dialogues are needed to understand the options available to enhance blue carbon storage in the Southeast.

RESPONSE: Consortium staff participated in a roundtable dialogue (with colleagues from Georgia Sea Grant, USGS, and Woods Hole Oceanographic Institution) to describe the opportunities, challenges, and information needs associated with blue carbon as a link for public-private partnerships in the Southeast. Attendees included restoration practitioners, bankers, and shareholders interested in the blue carbon market. Consortium staff educated the participants on blue carbon, associated co-benefits for coastal and marine ecosystems, and the work needed to conduct successful coastal restoration.

RESULTS: The roundtable group committed to meeting quarterly and expand its members to continue the discussion of the future of blue carbon. Additionally, Consortium staff were encouraged to submit a proposal to the First Horizon Bank Foundation to enhance regional (Southeast, Gulf coast, Caribbean) research on blue carbon options. The Consortium proposed the Southeast Blue Carbon Database research project—which received funding.

PARTNERS: Georgia Sea Grant, University of Georgia, National Sea Grant Law Center, U.S. Geological Survey, First Horizon Bank, East Tennessee State University Research Corporation

S.C. Sea Grant Consortium, Georgia Sea Grant, and University of Georgia Plan Inaugural Blue Carbon Law Symposium

Brita Jessen, S.C. Sea Grant Consortium
Katie Hill, Georgia Sea Grant
Adam Orford, University of Georgia School of Law

RECAP: The S.C. Sea Grant Consortium (Consortium) partnered with Georgia Sea Grant and the University of Georgia (UGA) School of Law to plan and host the first Blue Carbon Law Symposium (scseagrant.org/blue-carbon-law-symposium) to be held at UGA in May 2023 and publish a special issue of the *Sea Grant Law & Policy Journal* focused on blue carbon.

RELEVANCE: Blue carbon crediting has the potential to support the development of healthy coastal ecosystems by long-term conservation, restoration, and sustainable management of coastal and tidal habitats. Key issues to generate blue carbon crediting on publicly held lands include property ownership, boundary shifts, easement agreements, and legal authority by public agencies to authorize or engage with crediting. To date, no conference in the United States has been convened to address these issues and assemble a cross-disciplinary audience.

RESPONSE: Consortium staff and partners recruited a steering committee to develop a 1.5-day agenda that convenes legal scholars, ESG (Environmental, Social, and Governance) investors, conservation finance and carbon registry specialists, coastal and marine decision-makers, and scientists to co-create a whole-field understanding of the role and opportunity for coastal blue carbon investment.

RESULTS: The Blue Carbon Law Symposium was developed. Invited speakers include experts in law, ecosystem science, community engagement, and finance; a senior counsel at the Council for Environmental Quality; and the NOAA Chief Scientist.

PARTNERS: Georgia Sea Grant, University of Georgia, National Sea Grant Law Center

S.C. Sea Grant Consortium Researchers Measure Microplastics in Sediments and Shrimp of South Carolina Waterways

Andrew Tweel, S.C. Department of Natural Resources

RECAP: S.C. Sea Grant Consortium (Consortium) researchers and students are currently conducting a study of the distribution of microplastics in sediments and shrimp in South Carolina. Building capacity at S.C. Department of Natural Sources (SCDNR) to analyze the distribution of microplastics in sediment and Panaeid shrimp allows researchers to include such analyses in monitoring programs.

RELEVANCE: Microplastics in the marine environment have gained increasing attention in recent years, yet their coast-wide distribution in the estuarine habitats of South Carolina remain largely unknown. Preliminary data suggests that microplastics commonly occur throughout our estuaries, yet factors related to the prevalence of these contaminants and their distribution among penaeid shrimp has not been well studied.

RESPONSE: Consortium-funded researchers have established new laboratory capacity to analyze microplastics at the Marine Resources Research Institute (SCDNR). Sediment and shrimp samples were collected to determine: 1) the types, abundances, and distribution of microplastics in sediment in estuaries along the SC coast; 2) the spatial patterns which may correlate to microplastic type or abundance, such as level of development; and 3) the prevalence of microplastic particles in Penaeid shrimp in South Carolina.

RESULTS: Early data have been presented by a graduate student at three conferences within the state. Additionally,

the researchers have worked with the Coastal Reserves and Outreach office of S.C. Department of Natural Resources to develop educational materials related to microplastics in SC. This includes a set of laminated one-pagers, demonstration kit of the density separation process, and petri dishes with example materials for microscope analysis by school groups.

PARTNERS: College of Charleston

S.C. Sea Grant Consortium Researchers Investigate Physiology of Harvested and Bled Horseshoe Crabs

Daniel Sasson, S.C. Department of Natural Resources
Jody Beers, College of Charleston
Fabio Casu, National Institute for Standards and Technology

RECAP: To better understand the physiological response to collection and blood extraction from horseshoe crabs (a keystone ecosystem species), S.C. Sea Grant Consortium (Consortium)-funded researchers are investigating horseshoe crab harvest and bleeding across age classes to examine crab metabolic rates and blood profiles.

RELEVANCE: Horseshoe crabs (listed as vulnerable by the IUCN) are a critical keystone species of the Atlantic coast, providing essential nutrition for migrating sea and shore birds and other marine predators. Horseshoe crab blood is collected for human pathology laboratories to identify bacterial infection. While the total mortality of the collected and returned crabs is recorded by industries, much less is understood about the physiological fitness of the crabs after collection and bleeding.

RESPONSE: Consortium-funded researchers are examining the metabolic rate and metabolite products in horseshoe crab blood following collection and bleeding.

RESULTS: Early results indicate that age plays a factor in the types of blood profiles following collection and bleeding. While conducting this work, the PIs and graduate student have attended multiple public outreach events at schools and on local beaches to talk about horseshoe crab biology, ecology, and ongoing research.

Researchers Engage Stormwater Managers to Identify Ponds for Research on Phosphorus Dynamics and Water Quality

Debabrata Sahoo, Amy E. Scaroni, and C. Guinn Wallover, Clemson University
Erik Smith, University of South Carolina
Brooke R. Sarri, S.C. Sea Grant Consortium

RECAP: Scientists and extension agents worked with stormwater managers, workers, and technicians from the City of Charleston, Charleston County, and Horry County to identify stormwater ponds to study links between phosphorus dynamics, overall water quality, and the negative impact of algal blooms. These interactions led to the selection of suitable sites, the development of effective sampling protocols, and increased engagement from the project team.

RELEVANCE: Stormwater ponds are the most common (over 9,000 in coastal South Carolina) control structures used to meet permit requirements for land development in coastal South Carolina. While these ponds are designed to control flooding, they may also act as a water quality enhancement feature. Recently, residential areas have

experienced increases in algal blooms likely due to increased nutrient input (such as phosphorus).

RESPONSE: S.C. Sea Grant Consortium-funded researchers are working with stormwater managers and technicians to identify residential stormwater ponds at different age classes in order to study the correlation between stormwater pond age and phosphorus (P) dynamics. The study evaluates whether sediment acts as a source or sink of water column P over time, as sediment P sorption capacity decreases with increased P loading. All members of the project team are working directly with partners.

RESULTS: Site visits were conducted at stormwater ponds around Charleston to verify their age and accessibility, and finalize sampling protocol with the research committee.

PARTNERS: City of Charleston, Charleston County, Horry County

S.C. Sea Grant Consortium Researchers Investigate Benefits of Floating Wetland Installments for Stormwater Pond Quality

Bill Strosnider and Matt Kimball, University of South Carolina
Sarah White and Amy E. Scaroni, Clemson

RECAP: To better understand the potential of floating treatment wetlands as water quality enhancement in coastal stormwater ponds, S.C. Sea Grant Consortium (Consortium)-funded researchers conducted initial field sampling, experimental treatments of wetland plant growth under brackish conditions, and focus group dialogues with South Carolina residents to understand perceptions and maintenance concerns regarding coastal stormwater ponds.

RELEVANCE: Mitigation of contaminants in coastal-area, brackish ponds is critical because of their role as a last defense before stormwater impacts estuaries and coastal waters. Floating treatment wetlands (FTWs) are an increasingly applied and inexpensive constructed wetland technology that can be deployed in existing stormwater infrastructure. Since FTWs are a nascent technology, significant questions remain regarding contaminant processing capacity and habitat creation potential.

RESPONSE: Consortium-funded researchers are taking a multi-scale approach (greenhouse/mesocosm and field) to measure the ecological conditions for potential stormwater pond plant species to thrive, and the remediation benefit of floating treatment wetlands in brackish ponds. Additionally, team members are working with homeowners associations and stormwater pond managers to identify maintenance needs and goals while providing information on the potential benefits and outcomes of floating treatment wetlands. Results will be shared with pond owners and managers.

RESULTS: Potential field sites were surveyed in early 2022, and three suitable stormwater ponds were identified. Sampling efforts began in spring 2022, and these data will serve as the pre-treatment baseline data prior to application of the floating wetland treatment in spring 2023. Focus groups of coastal residents were also conducted to determine priorities regarding community ponds, and results were used to develop an online survey for distribution in spring 2023.

PARTNERS: Charleston Aquatics and Environmental, Inc., Beemats Floating Wetlands, Town of Mount Pleasant, Old Village Landing Homeowners Association, pond management professionals employed by The Lake Doctors, Inc. and The Greenery, Inc.

S.C. Sea Grant Researchers Developing New Tool to Model Compound Flooding

Timothy Callahan, College of Charleston

RECAP: S.C. Sea Grant Consortium (Consortium)-funded researchers are studying the causes and impacts of compound flooding from multiple sources (rainfall, stormwater, and tidal inundation) in local areas of Charleston County in order to create a map-interface tool that allows municipal decision-makers to plan for novel flood conditions.

RELEVANCE: In the last decade coastal S.C. has faced unpredictable compound flooding, where multiple flooding sources (stormwater runoff and tidal inundation) occur on the landscape at the same time. Sea-level rise, intense rainfall, and landscape change lead to a new type of flooding in this compound flooding zone where floodwaters from stormwater runoff collide with tidal floodwaters moving inland. Expanded information on compound flooding is needed for region-specific management decisions.

RESPONSE: Consortium-funded researchers and students are conducting a compound flooding risk study based on field data from two different sites (high urban density and semi-rural) near Charleston County and incorporate past and current research on compound flooding into a map-based tool for communication and decision-making with applicable predictions of areas that will be increasingly subject to compound flooding.

RESULTS: Tidal creek sites were established at Stono Preserve in Hollywood, SC, and Shem Creek in Mount Pleasant, S.C. where discharge and salinity measurements are collected biweekly, dependent on tidal conditions and precipitation. A discharge rate model is also being calibrated for incorporation into a map-based tool.

PARTNERS: Town of Mt. Pleasant Stormwater Management, Xylem, Inc., Creekside Neighborhood Association (Mt. Pleasant), Charleston Waterkeeper

S.C. Sea Grant Consortium Researchers Study Avian Biodiversity in Ephemeral Wetland Habitats

Daniel McGlinnn and Lucy Davis, College of Charleston
Stacey Lance, Savannah River Ecology Laboratory
Lisa Lord, The Longleaf Alliance

RECAP: S.C. Sea Grant Consortium (Consortium)-funded researchers are measuring avian habitat use and biodiversity in ephemeral wetlands within a coastal-forested system in comparison with upland habitat in order to measure the effects of management (tree thinning) designed to promote ephemeral wetland sites.

RELEVANCE: Ephemeral wetlands are unique habitats that occur in spatially isolated locations in forested landscapes and are sensitive to changes in hydrology and land-use change. They are also important repositories of bird biodiversity, yet are understudied. In order to determine the consequences of both ephemeral wetland loss and restoration potential, more research is needed to understand the use of ephemeral wetlands by avian communities.

RESPONSE: Consortium-funded researchers are conducting a comparative field study of avian biodiversity in wetland and upland habitats. They are examining whether bird biodiversity is higher in ephemeral wetlands compared to surrounding upland savannas, if the degree of species turnover, or beta diversity, is different between wetlands and uplands, and finally, what environmental variables drive species composition and biodiversity within

ephemeral wetlands.

RESULTS: The researchers found that wetlands were significantly more diverse and had more birds than uplands. Species such as blue-gray gnatcatchers, red-bellied woodpeckers, and great crested flycatchers were more common in wetlands. At this time the variation of wetland biodiversity and species composition has not correlated with vegetation metrics.

PARTNERS: Folk Land Management, Halidon Hill, Quinby Plantation

S.C. Sea Grant Consortium Researchers Investigate Ocean Acidification in Long Bay, S.C.

Angelos K. Hannides, Danielle Viso, and Susan Libes, Coastal Carolina University
Janet Reimer, Southeast Ocean and Coastal Acidification Network (SOCAN)
Emily Hall, Mote Marine Laboratory

RECAP: S.C. Sea Grant Consortium (Consortium) researchers are undertaking a study and associated outreach activities to measure the spatial and temporal extent of coastal ocean acidification (which may have negative impacts on shellfish production in coastal waters) and communicate the causes and effects of ocean acidification to residents and teachers.

RELEVANCE: Coastal ocean acidification (OA) can have a detrimental impact on shellfish production and survival. Hypoxia events (extended periods of low dissolved oxygen) have been detected by continuous sensors in Long Bay, SC, where a major shellfishery exists. Hypoxia may drive increased OA. A study is therefore needed to characterize temporal and spatial scales of OA in Long Bay and provide education resources to the public about potential effects of OA in coastal waters.

RESPONSE: Consortium-funded researchers conducted field sampling for acidification components on Long Bay for analysis. All information on the project will be placed on the Southeast Ocean and Coastal Acidification Network (SOCAN) webpage (www.socan.secoora.org/coastal-carolina).

RESULTS: All field sampling was completed and analysis is underway to characterize temporal and spatial scales of coastal ocean acidification in Long Bay, S.C. Additional outreach included a presentation to the S.C. Marine Educators Association meeting and planning for an ocean acidification module for the Teachers on the Estuary program with the two S.C. National Estuarine Research Reserves.

Consortium Works with Coastal Carolina University Engineering Students to Investigate Marine Debris in Capstone Project

Katie Finegan, S.C. Sea Grant Consortium and Coastal Carolina University
George Hitt, Coastal Carolina University

RECAP: The S.C. Sea Grant Consortium tasked a group of engineering students with developing an innovative solution for marine debris in South Carolina for their senior capstone project. The Consortium provided mentorship to the team of engineering students over the fall semester as they brainstormed ideas to further pursue in the spring semester.

RELEVANCE: As required by Accreditation Board for Engineering and Technology, students in the engineering science program must have a culminating major engineering design experience that incorporates appropriate engineering standards and multiple constraints and is based on the knowledge and skills acquired in earlier coursework. During the fall semester, students work on analysis of the problem and study feasible solutions. In the spring semester, the students will further the solutions through prototypes, modeling, and redesign.

RESPONSE: The Consortium developed a project description that tasked a team of students to come up with an innovative marine debris solution for South Carolina. Students were asked to solve how to clean up marine debris once it enters stormwater ponds, lakes, rivers, marinas, harbors, and the ocean.

RESULTS: During the fall semester, the coastal processes specialist met with the student team regularly to provide input, feedback, and answer questions generated by the team as they brainstormed the feasibility of potential solutions. The semester ended with the team presenting their ideas to the Consortium and identifying a solution to further pursue. In the spring semester, the student team will continue to develop their chosen solution with guidance from the coastal processes specialist.

S.C. Sea Grant Consortium Developing Online Tool to Estimate Bacteria Sources and Loading Rates at a Watershed Scale

Landon Knapp, S.C. Sea Grant Consortium and College of Charleston
Brooke R. Saari, S.C. Sea Grant Consortium
Norman Levine and Morgan Peshoff, College of Charleston
Amy Scaroni and Raghupathy Karthikeyan, Clemson University

RECAP: In response to the growing number of water bodies impaired by bacteria pollutants in South Carolina, the S.C. Sea Grant Consortium formed a collaborative team to create an online tool to assess fecal bacteria pollution sources for use by watershed and stormwater managers.

RELEVANCE: South Carolina has roughly 1,200 impaired water bodies, with bacteria the cause of over half of these impairments. Additionally, there are concerns that sea-level rise and extreme precipitation events could impede proper functioning of septic systems, potentially further exacerbating this issue. Impaired water bodies can have a variety of negative impacts on overall public health, economic health, and ecosystem health. There are limited tools available to assist with estimating fecal bacteria pollution loading rates.

RESPONSE: A collaborative project team was formed to plan and develop a geographic information system-based tool (GIS) for assessing fecal bacteria pollution sources and loading rates on a watershed scale. S.C. Sea Grant Consortium staff began work on the tool as part of the project team, including GIS data analysis and engagement with environmental organizations to ensure proper sourcing and application of pollution datasets.

RESULTS: Funding was obtained ($22,281) from the Clemson University South Carolina Water Resource Center to create the tool and a graduate student was hired at the College of Charleston for data sourcing and tool construction. Tool completion date will be late 2023, followed by training and outreach efforts for watershed and stormwater managers.

PARTNERS: College of Charleston, Clemson University