



SOUTH CAROLINA SEA GRANT CONSORTIUM

Impacts and Accomplishments

FY 2020-2021



S.C. Sea Grant Consortium
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HEALTHY COASTAL ECOSYSTEMS

IMPACTS

S.C. Sea Grant Consortium Co-Organizes Grand Strand Regional Stormwater Pond Management Conference

April Turner and Brooke Saari, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium co-organized a pond management conference, providing training and technical assistance to build capacity and inform more than 150 stormwater professionals, homeowners, and local government officials and staff in Myrtle Beach, S.C. Conference planning for 2021 is underway for Beaufort County and the greater Charleston area coastal communities.

Relevance: Stormwater ponds are the most common structural best management practice for regulating stormwater runoff in the highly developed areas of coastal S.C. Ponds play a significant role in watershed function, providing for flood management and pollution mitigation; they also are regarded as amenities. Without regular inspections and proper maintenance, ponds can be transformed from pollutant sinks to pollutant sources, having implications for downstream ecosystem and human health.

Response: The Consortium co-organized a regional pond conference in February 2020, extending the latest stormwater pond scientific information, resources, and tools to public- and private-sector pond managers and owners. The goals were to: increase awareness of the purpose of ponds and their need for regular maintenance; provide information and tools to overcome common challenges in pond management; and integrate pond owner and pond manager audiences with service providers to assist with inspections and management actions.

Results: Over 150 participants attended the conference. The event was an opportunity for participants to hear from local and regional experts, interact with organizations and businesses in the pond management industry, and receive valuable information and continuing education credits. The Consortium's effort for this conference is estimated to have provided an economic benefit of \$13,279 based on the provision of continuing education credits at a discounted rate, registration fees, travel costs, and opportunity costs of time.

Partners: Clemson University Cooperative Extension; Georgetown County, S.C.; Horry County; North Inlet-Winyah Bay National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); Myrtle Beach, S.C.; Coastal Waccamaw Stormwater Education Consortium

S.C. Sea Grant Consortium Co-Organizes Regional Grand Strand Healthy Pond Series

Brooke Saari, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium played an essential role in planning and organizing the Grand Strand and North Coast Healthy Pond Series in September and December of 2020.

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. These needs did not diminish during COVID-19, leading to virtual-based Programming opportunities.

Response: The Consortium, along with Partners, organized and implemented a regional virtual stormwater pond education series called the Grand Strand Healthy Pond Series. A total of four interactive webinars, two of which were during this reporting period, focused on extending the latest stormwater pond scientific information, resources, guidance, and tools to pond managers and owners. The goal of the webinars was to create an opportunity for pond owners to learn about and share pond management techniques.

Results: A post-event survey (23% response rate) revealed respondents increased knowledge (92%) and indicated they learned something new (85%). Participant feedback showed that attending these events was a good use of their time (92%) and indicated excitement over upcoming opportunities. The planning, organization, and administration provided by the Consortium for the 2020 Grand Strand and North Coast Healthy Pond Series is estimated to have provided an economic benefit of \$965 based on opportunity costs of time.

Partners: Clemson University; University of South Carolina (USC); North Inlet-Winyah Bay National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS)

ACCOMPLISHMENTS

S.C. Sea Grant Consortium Researchers Analyze Impacts of Development on Estuarine Habitat Quality

Andrew Tweel and Denise Sanger, S.C. Department of Natural Resources

Recap: S.C. Sea Grant research has demonstrated that there are significant positive relationships between various metrics of sediment contamination (ERMQ) and development intensity, precipitation amount, and temperature. While the correlation to development intensity is fairly well documented, the potential compounding effect that increases in temperature and/or precipitation may have may exacerbate this relationship, leading to increases in contamination at already-impacted sites or an increase in the proportion of sites identified as impacted.

Relevance: Preliminary analysis of several long-term environmental datasets reveals that high-density development increases sediment toxicity and degrades water quality but does not seem to significantly impact benthic communities. As coastal populations continue to grow, increasing stress is placed on downstream ecosystems. These relationships between watershed land use and estuarine quality have been quantified at a variety of spatial scales and response variables. How these relationships will interact with predicted changes in climate and weather patterns, however, has not been identified. Coastal planners and stormwater managers can utilize this information to design best management practices that account for increases in stormwater runoff, install targeted retrofits of stormwater infrastructure to maximize benefit, and to predict and manage potential decreases in environmental quality before water bodies are classified as impaired.

Response: S.C. Sea Grant Consortium researchers at the S.C. Department of Natural Resources (SCDNR) are synthesizing several long-term environmental monitoring datasets, dating from the 1990s to present. Several databases have been compiled to house water quality, environmental, land-cover, and weather data.

Results: Initial water quality data demonstrated that some indicators, such as fecal coliform bacteria, are responsive to short-term precipitation patterns, while other indicators, such as sediment contamination, are more strongly correlated to seasonal-level precipitation patterns. Predictive modeling tools pointed to a decline in the overall quality of the estuarine environment under climate change and population growth.

Partners: Carolina's Integrated Sciences and Assessment Center; National Oceanic and Atmospheric Administration (US DOC, NOAA)

Urban Stormwater Runoff as a Source of Microplastic and Tire Wear Particles in Coastal Waterways: Transport, Cumulative Impacts to Biota, and Mitigation

Peter van den Hurk, Clemson University

John Weinstein, The Citadel

Barbara Beckingham, College of Charleston

Recap: Consortium researchers have begun characterizing the role of stormwater runoff as a pathway of microplastic entry into our coastal waterways, hoping to inform policy and management decisions that minimize the environmental and economic impacts of this type of debris in the future

Relevance: Marine plastic debris is considered to be a top environmental problem, and an emerging global issue that may 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 was found to be black fragments from tire-wear particles produced through the abrasion of tires on road surfaces.

Response: S.C. Sea Grant 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.

Results: Field monitoring locations for both stormwater pond and storm sewer inlet devices were identified and visited in coordination with the Town of Mt. Pleasant Stormwater Division. Laboratory work has included optimization of sediment processing methods and also chronic toxicological assessments with a vertebrate model.

Partners: Crystalstream Technologies; Town Of Mount Pleasant Stormwater Program

S.C. Sea Grant Researchers Measuring Marsh Sensitivity to Increased Flow and Sea Level Rise

Thomas O'Halloran, Clemson University

Erik Smith, University of South Carolina

Recap: Measuring marsh productivity and sensitivity related to environmental drivers is essential to understanding how salt marshes will respond to future changes in sea level. S.C. Sea Grant research will inform models on how marshes build vertical elevation that allows them to adapt to sea level rise.

Relevance: Along the Southeast U.S., intertidal salt marshes represent a critical habitat at the interface of the terrestrial and marine environments, performing a variety of ecological functions and services that make them of great economic importance for coastal communities. Salt marshes stabilize the shoreline and represent the first

line of defense against flood and storm events, and they provide essential fish and shellfish habitat. However, the ability of intertidal marshes to maintain their elevation and persist in the face of rising sea level is dependent on relationships between tidal inundation, plant growth, and accretion of organic matter and sediments. Measuring marsh productivity and sensitivity related to environmental drivers is essential to understanding how salt marshes will respond to future environmental and man-made stressors.

Response: To enable better prediction, S.C. Sea Grant Consortium researchers are measuring marsh production from tidal to seasonal time- scales. This information is essential to determining the importance of future physical changes on South Carolina's coastal ecosystems due to increased variability in freshwater flow and sea level rise. In particular, project results will lead to the improvement of models that forecast salt marsh responses to changes in sea level.

Results: Researchers have had success collecting significant data on salt marsh production and related environmental drivers. Additionally, a network of instrumented towers was erected to facilitate synthesis and modeling analyses that advance carbon cycle science. Pending final analysis of results, soil flux and photosynthesis measurements will inform models on how marshes build vertical elevation that allows them to adapt to sea level rise.

Partners: Bryn Mawr College; Marine Biological Laboratory (MBL, WHOI); University of Georgia (UGA); Rutgers University

S.C. Sea Grant Consortium Stormwater Ponds in Coastal South Carolina: State of Knowledge Report is Valuable Resource for Pond Managers and Residents

Brooke Saari, S.C. Sea Grant Consortium

Recap: Since publication in 2019, the Stormwater Ponds in Coastal South Carolina: State of Knowledge Full Report and Executive Summary continue to be useful and valued resources for South Carolina researchers, natural resource decision-makers, pond managers, and residents.

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 stormwater ponds, coastal residents, stormwater managers, and researchers need to have access to the most relevant information, tools, and resources in order 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 Stormwater Ponds in Coastal South Carolina: State of Knowledge Full Report, published in 2019, and the Executive Summary, published in 2018. Since publication, the full report and the executive summary serve as outreach products to improve knowledge regarding stormwater ponds.

Results: The executive summary of the report was provided to various audiences since publication in 2018, with more than 300 hard copies distributed and 171 digital copies downloaded (51 downloads this past year). The full report, published in 2019, has been accessed online 325 times, and the PDF was downloaded 113 times. These products also have been used and distributed by other extension and outreach organizations, such as Clemson Extension and the Ashley Cooper Stormwater Education Consortium.

S.C. Sea Grant Consortium Develops New Coastal Environmental Quality Extension Advisory Committee

Brooke Saari, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium (Consortium) continues to build capacity and external Partnerships through establishment of the Coastal Environmental Quality (CEQ) Extension Advisory Committee.

Relevance: In April 2020, the Consortium hired a CEQ Program specialist to establish a sustainable extension Program within the Healthy Coastal Ecosystems Programmatic focus area and to address issues related to stormwater within South Carolina. Building a successful extension Program requires inclusive and constructive collaboration with Partners throughout the state to enhance reach into the important communities served.

Response: In August 2020, the Consortium convened the first CEQ Extension Advisory Committee meeting. The purpose of the committee is to discuss and identify current issues impacting coastal natural resources and the communities dependent upon them, and assisting with the formulation of solutions to address the identified needs of constituents developed through strategic planning priorities. Several relevant stakeholder groups with an interest in healthy coastal ecosystems participated, resulting in a committee of nine Partners.

Results: Feedback was gathered on priority updates to the Consortium's strategic plan and CEQ focus areas. Three CEQ Program focus areas were created as a result of this input: stormwater, water quality, and environmental health. Input is continually sought to build and support Programming efforts as this Program area gains momentum.

S.C. Sea Grant Consortium Participates in South Carolina Harmful Algal Bloom Network

Brooke Saari, S.C. Sea Grant Consortium

Recap: The mission of the South Carolina Harmful Algal Bloom Network (SC HABNet) is to create a network of agencies with environmental, human health, or wildlife resource management responsibilities and universities conducting research relevant to harmful algal bloom (HAB)-associated subjects. The purpose of the group is the sharing of expertise and resources between members to encourage collaboration and coordination of existing activities. The Consortium serves on this task force and contributes to the coordination, outreach, and branding.

Relevance: Harmful algal blooms (HABs) result from the rapid growth of potentially harmful algae and are found in fresh, brackish, and saltwater ecosystems. These HABs can produce toxins that could be harmful to people, animals, and local ecology. The South Carolina Harmful Algal Bloom Network was reinvigorated, carrying on a previous effort from 1997-2005, and brought members back together to encourage collaboration on HAB response and education.

Response: The Consortium joined the South Carolina Harmful Algal Bloom Network and helped to coordinate branding, website content discussions, and educational efforts. The Consortium is involved with the outreach committee and has created a logo for the Network, along with providing education Program design input.

Results: The Consortium's Coastal Environmental Quality Program specialist and web developer/graphic designer led the effort to design a new logo to represent the South Carolina Harmful Algal Bloom Network (SC HABNet), and these two staff continue to move forward with initiating identity and branding efforts. The staff also served on the website design and content team through their participation in the outreach committee.

Partners: South Carolina Department of Health and Environmental Control (SC DHEC); South Carolina Department of Natural Resources (SC DNR); Clemson University; Coastal Carolina University (CCU); Medical University of South Carolina (MUSC); University of South Carolina (USC); Belle W. Baruch Institute for Marine and Coastal Science; US Geological Survey (US DOI, USGS); Clemson University Cooperative Extension; National Oceanic and Atmospheric Administration (US DOC, NOAA)

S.C. Sea Grant Consortium Develops Methods to Document Ecosystem Service Benefits of Beaches and Barrier Islands

Matt Gorstein, S.C. Sea Grant Consortium

Recap: An outreach document and methods appendix to document the economic benefits of beaches and barrier islands in South Carolina were both drafted and reviewed by external experts

Relevance: South Carolina's beaches and barrier islands, including beaches, dunes, and wetlands produce a wide variety of benefits, contributing to the culture, lifestyle, and well-being of its residents. South Carolina's beaches and barrier islands provide its residents and visitors with jobs, recreational opportunities, coastal protection, critical habitat for bird and turtle species, and aesthetic beauty, among other ecosystem services.

Response: An investigation of existing data and literature was conducted to better characterize the estimated economic benefits of South Carolina's beaches and barrier islands, including both market and non-market benefits. Ecosystem service valuation studies are selected for benefit transfer based on the appropriateness of the estimate(s) for South Carolina. Employing this method allows us to utilize an ecosystem service framework to estimate the economic benefits of beaches and barrier islands in South Carolina, at statewide scale.

Results: The Consortium was able to estimate value ranges for the following ecosystem services provided by beaches and barrier islands in South Carolina: Recreation (\$1.52 billion - \$3.09 billion per year); coastal protection provided by wetlands (\$329 million - \$447 million per year); carbon storage (\$1.72 million - \$5.12 million per year); water quality protection (\$66.54 million - \$83.08 million per year); water supply protection (\$4.21 million - \$5.33 million per year); and the presence of sea turtle habitat (\$8.80 million - \$12.55 million per year).

SUSTAINABLE COASTAL DEVELOPMENT AND ECONOMY

IMPACTS

S.C. Sea Grant Consortium Assists McClellanville Community with Sustainable Working Waterfront Planning

April Turner and Graham Gaines, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium continued to collaborate with McClellanville, its citizens, industry Partners, the watermen, and local nonprofits to implement a much-needed comprehensive master plan and viable business model to protect and sustain the cultural and economic values of the town's working waterfronts.

Relevance: As many traditional working waterfronts become vulnerable to high-end residential development and commercial activity, much of the South Carolina commercial seafood industry has been affected by changes in waterfront property use. The changes make it increasingly difficult for commercial fishermen to secure dependable and affordable docking space, fuel, and ice. This is cause for concern among the McClellanville watermen and the community, as the town's largest seafood business owner is approaching retirement and the future of the working waterfront is uncertain.

Response: Recognizing that the seafood industry is a core economic and cultural asset, the town reached out to S.C. Sea Grant Consortium for assistance with the "Preserving McClellanville's Working Waterfront Initiative." The Consortium and Partners collaborated to implement a much-needed comprehensive master plan and viable business model, ensuring that the cultural and economic values of the town's working waterfronts are not lost. Funding from municipal economic development grants were leveraged with the Consortium's S.C. Coastal Communities Initiative mini-grants. Input from community visioning sessions and recommendations from the waterfront master plan were used to further initiative goals.

Results: Efforts are underway to develop a marketing campaign centered around the watermen, local seafood businesses, and community history, as well as capacity building through the establishment of a nonprofit, the McClellanville Community Foundation, to assist with working waterfront ownership and protection. The Watermen's Association has been formed and a business model selected for cooperative ownership and operation of wholesale and retail seafood distribution. The Consortium will continue to work with the town, industry experts, the newly established nonprofit, and the watermen to implement the actions outlined in the master plan.

Partners: East Cooper Land Trust; Robin Payne Consulting; Carolina Common Enterprise; McClellanville Community Foundation; McClellanville Watermen's Association; McClellanville, S.C.

S.C. Sea Grant Consortium and Partners Train Real Estate Agents through "Calling the Coast Home" Continuing Education Series

April Turner, Sarah Watson, and Susan Lovelace, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium and Partners created and taught a series of accredited continuing education courses for 347 real estate professionals. Fifteen virtual trainings were conducted, providing information and

resources about important coastal issues for agents to share with clientele. Further offerings have been requested and scheduled in 2021.

Relevance: South Carolina's coastal population is rapidly growing. In recent years, it has become clear that real estate professionals (REPs) are a key audience for new information and resource sharing because they are often the primary contact for newcomers to the coast. In addition to their connection to new residents and business owners, REPs can influence natural resource policy and decisions since their industry relies on healthy coastal resources and resilient communities.

Response: As part of a S.C. Coastal Information Network (SCCIN) project to provide science-based information on important issues, the Consortium collaborated with several Partners to develop continuing education electives for coastal real estate professionals (REPs). Key REPs were engaged to identify course topics and provide guidance throughout curriculum development. "Calling the Coast Home" was developed as a series of four courses addressing the topics of coastal ecosystem/biodiversity, water quality, flooding and flood maps, and rebuilding regulations.

Result: Courses were piloted in January 2020. Due to COVID-19, courses then were presented virtually. 347 REPs participated in one of 15 two-hour trainings and received licensing credit. The SCCIN website offers resources for REPs to reference as they help prospective clients. The Consortium's effort for these trainings is estimated to have provided an economic benefit of \$10,848 based on the provision of continuing education credits at a discounted rate and opportunity costs of time.

Partners: South Carolina Coastal Information Network; South Carolina Department of Natural Resources (SC DNR); ACE Basin National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); North Inlet-Winyah Bay National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); South Carolina Department of Health and Environmental Control (SC DHEC); Clemson University

S.C. Sea Grant Consortium Builds Capacity Within Gullah Geechee Chamber of Commerce and Helps Obtain Federal Funds Eligibility

Matt Gorstein, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium develops Partnership with the Gullah Geechee Chamber of Commerce and helps them apply for federal funding.

Relevance: Identifying strategies to promote equity in sustainable economic opportunity is necessary for maintaining the well-being of coastal communities. In an era of climate change, it is also critical to address environmental justice issues and to understand the experiences of historically marginalized communities. With lucrative coastal industries like tourism, fishing and harvesting, and seafood dining continuing to grow in South Carolina, it's important to ensure that economic benefits are realized across the social and demographic spectrum.

Response: S.C. Sea Grant Consortium (Consortium) developed a Partnership with the Gullah Geechee Chamber of Commerce (Chamber), an organization that promotes businesses owned by Gullah Geechee members in S.C. and enhance economic opportunity for this community. The Consortium assisted the Chamber to develop project ideas that further both organization's goals, and developed a proposal for a Gullah Geechee Seafood Trail to promote seafood businesses owned by community members, and to share stories of maritime cultural heritage.

Results: The Consortium built capacity within the Chamber by walking them through System Awards Management

and grants.gov registration processes, making the Chamber eligible to apply for federal funds. The Consortium identified NOAA Saltonstall-Kennedy funds and played an essential role in obtaining eligibility for the Chamber, writing the grant proposal, organizing planning meetings, meeting grant proposal requirements, and submitting the grant on-time. A Consortium staff member devoted 60 hours to assist, which conservatively was worth \$2,817.

Partners: Gullah Geechee Chamber of Commerce

ACCOMPLISHMENTS

S.C. Sea Grant Consortium Develops Rapid Response RFP

April Turner and Graham Gaines, S.C. Sea Grant Consortium

Recap: The Consortium developed and was awarded a \$99,500 Direct Marketing Support project for the shellfish aquaculture and nature-based tourism industry, aimed at providing both immediate and long-term solutions to the impacts of COVID-19, all of which will begin in 2021. The “Rapid Response” activities address a vulnerable supply chain using a three-tiered approach: understanding consumer preferences, identifying regulatory obstacles, and direct support of online marketing efforts by S.C. seafood producers.

Relevance: COVID-19 caused many challenges for seafood businesses in South Carolina. Farmed shellfish is reliant on restaurants as an outlet for their product, with more than 65% of growers’ inventory going directly to restaurants. Soft-shell crab producers, the other major mariculture industry in S.C., suffered an 80% loss in 2020 sales. The pandemic has highlighted a major vulnerability in the local seafood supply chain, and presented an opportunity to learn how to improve that supply chain. To keep businesses open, prevent job losses, and boost the supply of sustainable seafood, determining best practices for alternative sales were needed.

Response: The Consortium worked with industry members to develop “Rapid Response” opportunities that would address the problems identified above. These solutions included: (a) understanding the potential for direct marketing of S.C. seafood products through a Study Group Partnership with the Clemson Marketing MBA Program; (b) developing a regulatory guide for retail or direct-to-consumer sales for seafood producers; (c) an aquaculture literacy campaign to promote the science behind year-round oyster sales; and (d) social media training courses for aquaculture producers. Included in this Rapid Response package were funds to support nature-based tourism.

Results: A total of \$99,500 was awarded to the Consortium for a Direct Marketing Support project for the shellfish aquaculture and nature-based tourism industries, aimed at providing both immediate and long-term solutions to the impacts of COVID-19

S.C. Sea Grant Consortium Scientists Examine Socioeconomic Aspects of Stormwater Control Measures to Guide Decision-Making in Coastal South Carolina

Marzieh Motallebi, Clemson University Baruch Institute of Coastal Ecology and Forest Science
Erik Smith, North Inlet-Winyah Bay National Estuarine Research Reserve
Daniel Hitchcock, Clemson University Baruch Institute of Coastal Ecology and Forest Science

Recap: S.C. Sea Grant Consortium research results in stormwater managers using cost-benefit methodologies to implement BMPs and related cost-benefit information being incorporated into a Realtor continuing education course “Calling the Coast Home.”

Relevance: Effectively managing stormwater has been an ongoing challenge in coastal South Carolina. Coastal development dramatically increases rates of stormwater runoff and impacts coastal resources. Stormwater management is thus a vital and required component of coastal zone development in the state. A great deal of research has been conducted in South Carolina on stormwater management practices, and a wealth of information exists on the design, management, and maintenance of a variety of stormwater best management practices (BMPs). In 2014, the Consortium and several of its Partners published *Low Impact Development in Coastal South Carolina: a Planning and Design Guide* (Guide), describing a variety of stormwater BMPs. While the Guide provided an initial economic analysis of the cost of implementing various BMPs, the limited analysis focused primarily on installation costs. Stormwater management research has been lacking in informing a full socioeconomic understanding regarding the various options for BMP implementation decisions.

Response: S.C. Sea Grant Consortium researchers at Clemson University and the University of South Carolina Baruch Institute built from the foundation provided in the Guide by adding necessary socioeconomic knowledge to better inform stormwater decision-making in coastal South Carolina. The effort examined detailed operation and maintenance costs, cost effectiveness, and benefit valuation of BMPs.

Results: Researchers designed a participatory story map for stormwater managers to include type and costs of their installed BMPs in the eight coastal counties, as well as a survey to select the most common BMPs in different coastal counties. Several economic analyses were performed to determine costs of installing and maintaining BMPs, and residential willingness-to-pay for related measures. As a result, the South Carolina Association of Stormwater Managers (SCASM), City of Mt Pleasant, City of Charleston, and City of Bluffton are using this methodology for cost benefit analyses of implementing BMPs in their areas. Additionally, cost-benefit information was incorporated into a Realtor continuing education course "Calling the Coast Home."

Partners: Coastal Waccamaw Stormwater Education Consortium; S.C. Association of Stormwater Managers; Clemson University Cooperative Extension; North Inlet-Winyah Bay National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); North Carolina Department of Environment and Natural Resources (NC DENR); North Carolina State University (NCSU); South Carolina Department of Natural Resources (SC DNR); Bluffton, S.C.; Charleston, S.C.; Mount Pleasant, S.C.

S.C. Sea Grant Consortium and Partners Organize Virtual Workshop on Low Impact Development

April Turner, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium co-organized a virtual workshop for 150 engineers, landscape architects, stormwater and plan-review staff, planners, and other design professionals, providing training focused on how to correctly use the compliance calculator tool for the *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* to increase implementation of better site design practices in coastal South Carolina.

Relevance: Many coastal decision-makers, stormwater management professionals, and design engineers find it challenging to implement low impact development (LID) techniques for mitigating stormwater impacts. They need expertise, guidance, and resources to remove barriers to implementing LID practices on the community level, neighborhood scale, and site scale. The *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* was published in 2014; however, a 2019 informal assessment revealed training was needed to introduce new users to the guide, demonstrate its utility, and dispel lingering perception issues surrounding the use of LID.

Response: Building on the “LID Hot Topics” workshop series in 2019, the Consortium and Partners organized a virtual training workshop, “Using the S.C. Coastal LID Guide,” on August 19, 2020. This two-hour training was based on user needs with a combination of presentations addressing better site design, LID best management practices and maintenance, local case studies, and demonstration design exercises using the compliance calculator tool and guide updates for runoff reduction credits, tree credits for volume control, and conservation credits.

Results: The workshop provided demonstration for site-design application and a Q&A session with the intent of increasing the guide’s use. More than 150 people attended, including engineers, landscape architects, stormwater and plan-review staff, planners, and other design professionals. To supplement the guide, a FAQ was created. In 2020, the LID guide resource webpage was accessed 121 times and the guide was downloaded 92 times. Evaluations indicated 96% of attendees thought participating was a good use of their time, while 92% indicated the workshop increased their knowledge of using the guide.

Partners: Center for Watershed Protection; Clemson University; ACE Basin National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); North Inlet-Winyah Bay National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS)

S.C. Sea Grant Consortium Provides Leadership to South Carolina Nature-Based Tourism Association

April Turner, S.C. Sea Grant Consortium

Recap: Through the activities of the Coastal Communities specialist, the S.C. Sea Grant Consortium has continued to support the South Carolina Nature-Based Tourism Association, providing technical assistance, conference planning, and small business promotion to help ensure the economic viability and resource sustainability of the South Carolina nature-based tourism industry.

Relevance: Tourism is an important economic driver for South Carolina, bringing in an estimated \$23.8 billion in 2019. While this was significantly curtailed by COVID-19 and the subsequent shutdowns, demand for nature-based tourism and outdoor recreation steadily increased in 2020. People are drawn to the South Carolina-both residents and tourists take advantage of the opportunities the state’s natural and cultural resources provide. In light of this increased demand, it is important to help ensure an economically viable and resource sustainable nature-based tourism industry in South Carolina.

Response: The S.C. Sea Grant Consortium (Consortium) supports sustainable statewide, nature-based tourism and outdoor recreation through its involvement with the South Carolina Nature-Based Tourism Association (SCNBTA). The Consortium’s Coastal Communities specialist continues to serve on the SCNBTA Board of Directors, providing technical guidance and leadership service, including Program planning for the quarterly board meetings, annual conferences and workshops, as well as coordinating and developing marketing and membership strategies.

Results: As the conference co-chair, the Coastal Communities specialist organized the virtual 2020 annual conference and coordinated the redevelopment of the SCNBTA website which was launched in March. The website overhaul promotes each of the state tourism regions and supports nature-based tourism and recreation businesses, providing increased exposure to potential clientele and the continued sustainability and viability of the SCNBTA.

Partners: S.C. Association of Tourism Regions; Charleston County Parks and Recreation Commission; South

Carolina Department of Parks, Recreation and Tourism (SC DPRT); South Carolina Department of Natural Resources (SC DNR)

S.C. Sea Grant Consortium Provides Rapid Response to Nature-Based Tourism Industries to Address COVID-19 Impacts

April Turner, S.C. Sea Grant Consortium

Recap: As a result of a Direct Marketing Support grant (\$22,500), the Consortium is engaged in activities to provide immediate and long-term solutions to mitigate the impacts of COVID-19 for the nature-based tourism industry. Rapid response activities underway include developing and implementing marketing strategies to strengthen the South Carolina Nature-Based Tourism Association and its small business members.

Relevance: Nature-based tourism businesses rely heavily on visitors to South Carolina's communities to increase sales. Many small businesses from this sector incurred financial burdens and disruption in service as a result of the shutdowns caused by the pandemic. As the tourism market begins to recover, it is important that this industry is visible in the marketplace so that locals and visitors are aware of sustainable nature-based and outdoor recreation opportunities.

Response: To assist with recovery and enhance future resilience to decreases in the demand for nature-based tourism, the S.C. Sea Grant Consortium (Consortium) received a Direct Marketing Support grant (\$22,500) and is working with regional tourism experts and agencies to develop and implement marketing strategies designed to highlight the nature-based tourism industry. Project efforts are focused on identifying ways to strengthen this sustainable sector now and into the future.

Result: The rapid response activities offer direct support to develop and implement marketing strategies for the South Carolina Nature Based Tourism Association (SCNBTA). SCNBTA is a nonprofit that has been educating and promoting its members, including outdoor outfitters and guide operations, for 25 years. Project activities to improve SCNBTA small business resiliency include website enhancements, a campaign plan for expanding membership, new marketing products and tools, and funding to support professional development opportunities in the nature-based tourism industry.

Partners: S.C. Association of Tourism Regions; South Carolina Department of Parks, Recreation and Tourism (SC DPRT); South Carolina Nature-Based Tourism Association

National Sea Grant Tourism Visioning: Building Partnerships with Sea Grant, Land Grant, and National Extension Tourism

April Turner, S.C. Sea Grant Consortium

Recap: Through the leadership efforts of S.C. Sea Grant Consortium, Georgia Sea Grant, Hawaii Sea Grant, and Oregon Sea Grant, members of the National Extension Tourism (NET) Design Team, greater integration and participation with the NET Network has resulted. The tourism visioning grant funds provide opportunities for increasing Sea Grant's ability to share best practices and strengthen relationships with Land Grant and other extension professionals working in tourism.

Relevance: Tourism plays a significant role in the economies of coastal and Great Lakes states, with significant

contributions to jobs, tax revenues, and quality of life. Science-based management of tourism in coastal communities is vital. Sea Grant has the opportunity to greatly increase the well-being of coastal communities by taking on a prominent role in tourism and outdoor recreation management science and community training through its research, extension and outreach, and communication Programs.

Response: Building on the previous work of the National Sea Grant 2018-2028 Sustainable Coastal Tourism Vision Plan, the S.C. Sea Grant Consortium, in Partnership with the Georgia, Hawaii, and Oregon Sea Grant state Programs, secured grant funding from the National Sea Grant Office (\$133,828) to further vision plan goals and recommendations.

Results: With this funding support, project Partners continued to worked with the NET Design Team to reestablish and strengthen relationships with Land Grant Extension engaged in tourism-related Programming. Other projects underway include involvement in planning for the 2021 NET Conference in Savannah, Ga., a sustainable tourism conference in Hawaii, the pilot expansion of Oregon's Guides and Outfitter Certification Program (GORP), and a Sea Grant Visioning Team meeting and professional development opportunity for Sea Grant staff involved with tourism.

Partners: Georgia Sea Grant; Hawaii Sea Grant; Oregon Sea Grant; National Extension Tourism Network

S.C. Sea Grant Consortium Expands South Carolina Coastal Information Network

April Turner, S.C. Sea Grant Consortium

Recap: For the past 14 years, the S.C. Sea Grant Consortium has managed the South Carolina Coastal Information Network, which enhances coordination of outreach efforts and the strategic dissemination of information to coastal communities.

Relevance: Communication and coordination among agencies and organizations in coastal South Carolina involved with providing outreach education to coastal communities has been challenging in the past. Information providers were often unaware of other similar outreach efforts underway targeting community leaders, local government staff, and residents. There was a need to avoid duplication of efforts, leverage scarce resources, and maximize Program benefits.

Response: Recognizing a need for improved communication and coordination among coastal outreach providers, the S.C. Sea Grant Consortium (Consortium) organized the South Carolina Coastal Information Network (SCCIN) in 2006. The Network consists of representatives from federal and state agencies, regional and local governments, and private organizations. Working with network Partners over the past 14 years, the network has developed and expanded to serve its common audiences in a more organized, coordinated, and efficient manner.

Results: The Consortium continued to facilitate and organize network meetings, which were held virtually on July 16 and December 11, 2020. The Consortium also is responsible for providing oversight and maintaining the SCCIN website, event calendar, and resource portal (www.sccoastalinfo.org), which had more than 5,463 page views in FY20-21 from visitors accessing the site's resources and events. SCCIN members have begun collaboration on the redevelopment of the S.C. LID Atlas to be launched in 2021.

Partners: Carolina Clear; Carolina's Integrated Sciences and Assessment Center; South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management; South Carolina Department of Natural Resources (SC DNR); Charleston Resilience Network; College of Charleston MES Program; Ashley-Cooper Stormwater Education Consortium; Coastal Waccamaw Stormwater Education Consortium; Town of Mount Pleasant

Stormwater Program; Clemson University Cooperative Extension; Berkeley- Charleston-Dorchester Council of Governments ; Lowcountry Council of Governments; Waccamaw Regional Council of Governments; Coastal Training Program (US DOC, NOAA, NOS, NERRS); Hollings Marine Laboratory (US DOC, NOAA, NIST, SC DNR HML); Office for Coastal Management (NOAA, NOS, OCM); SC DHEC Bureau of Water; South Carolina Department of Health and Environmental Control (SC DHEC); Clemson Baruch Institute of Coastal Ecology and Forest Science; South Carolina Forestry Commission ; U.S. Department of Agriculture Forest Service Southern Research Station Center for Forested Wetlands Research; Urban Land Institute

S.C. Sea Grant Consortium Develops First Ever Coastal Economics Extension Advisory Committee

Matt Gorstein, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium (Consortium) continues to build capacity in internal economic expertise through establishing its first ever Coastal Economics Extension Advisory Committee

Relevance: In August 2019, the Consortium hired a Coastal Economics Program Specialist for the first to address issues specifically related to coastal economics in the state: documenting economic benefits of coastal industries and marine resources, fostering sustainable economic development, and conducting socioeconomic analyses of residents and visitors to guide optimal decision making, among other efforts.

Results: Succeeding in building this Program requires inclusive and constructive collaboration with researchers, stakeholders, local officials, private industry, and other economics practitioners throughout the state.

Response: In August 2020, the Consortium convened its first ever Coastal Economics Extension Advisory Committee meeting to prioritize updates for our strategic plan. The purpose of the committee is to discuss and identify current issues impacting our coastal natural resources in South Carolina, and the communities that are dependent upon them. Several relevant stakeholder groups with an interest in coastal economics participated: economics professors; fisheries economics statistics experts; federal economists and social scientists; and stakeholders representing the Gullah Geechee Chamber of Commerce, the Gullah Geechee Sea Islands Coalition, and the S.C. Beach Advocates.

Partners: S.C. Beach Advocates; Office for Coastal Management (NOAA, NOS, OCM); Clemson University; University of South Carolina (USC); South Carolina Department of Natural Resources (SC DNR); College of Charleston; South Atlantic Fishery Management Council (SAFMC); Gullah Geechee Chamber of Commerce; Gullah Geechee Nation

S.C. Sea Grant Consortium Publishes Assessing South Carolina's Ocean Economy Report Documenting the Status and Trends of South Carolina's Ocean Economy

Matt Gorstein, S.C. Sea Grant Consortium

Recap: Consortium publishes Assessing South Carolina's Ocean Economy 2020 report to detail the status, trends, and future outlook for South Carolina's ocean economy.

Relevance: Documenting and monitoring the market and non-market economic benefits of ocean and coastal natural resources is important when evaluating policy decisions, and for understanding the level of dependence that a given coastal community may have on ocean and coastal natural resources. South Carolina's ocean and

coasts support a wide variety of industries including commercial fishing, recreational fishing, aquaculture, tourism, ports/harbors, shipbuilding, and sand mining.

Response: Datasets and relevant studies were identified, and the Assessing South Carolina's Ocean Economy 2020 report was drafted, reviewed by external experts, and published. The purpose of this report was to provide an overview of South Carolina's ocean economy based on the data available; expand upon information provided by NOAA to examine other market and non-market economic values derived from ocean resources; identify ocean economy sectors for potential future growth; and discuss how the health of natural resources provides a foundation for economic activities along the coast.

Results: The ocean economy contributed almost \$4.8 billion to South Carolina's gross domestic product (GDP) in 2017, 7.6% of total GDP in the eight coastal counties. Over 80,000 people were employed in the ocean economy in 2017, 12.2% of total employment in the eight coastal counties. Since the end of the recession (2009), ocean economy real GDP has increased by 53%, compared to 22% for the entire state economy. Assessing South Carolina's Ocean Economy was submitted as a nominee for the South Carolina State Library's Notable State Documents award.

S.C. Sea Grant Consortium Outlines Concept for Aquaculture Research and Training Study and Return on Investment Analysis

Matt Gorstein and Graham Gaines, S.C. Sea Grant Consortium

Recap: Concept is outlined to conduct shellfish aquaculture research and training Program feasibility study and return on investment (ROI) analysis.

Relevance: The growth of the shellfish aquaculture industry in the last few years has led to an increased interest in developing research and development to optimize sustainable shellfish production and survival rates and workforce training Programs to adequately train industry entrants in gear handling, shellfish science, and business planning.

Response: The Consortium identified an interested partner to conduct the ROI analysis. This assessment will utilize input-output modeling techniques to estimate the potential return on investment of constructing and operating a shellfish aquaculture research and training Program in South Carolina as measured through an economic impact analysis. Next steps include stakeholder meetings, data collection, implementation of the ROI analysis, and full feasibility study.

Results: Interested stakeholders from Consortium member institutions, technical colleges, and regulatory agencies were identified and invited to participate in a working group to define the scope and steer the assumptions of the ROI analysis.

S.C. Sea Grant Consortium Research Suggests Algal Production May Be Primary Source of Dissolved Oxygen Impairment in Stormwater Ponds

Erik Smith, University of South Carolina Belle W. Baruch Institute for Marine and Coastal Sciences

Recap: S.C. Sea Grant Consortium research on stormwater conveyances and control structures suggests that reducing particulate and algal loading from runoff could reduce oxygen demand in local receiving waters

Relevance: The presence of a sufficient minimum concentration of dissolved oxygen (DO) is a fundamental

requirement for sustaining aquatic life in coastal waters. Low DO is the number one cause of impairment to the ability of waters to support aquatic life use in South Carolina's coastal zone; however, preventing the occurrence of low DO remains a challenge for water quality management. Understanding the impacts of coastal development on water quality impairment, and specifically the prevalence of DO impairment, in coastal waters is vital to sustaining aquatic resources.

Response: S.C. Sea Grant Consortium researchers at the University of South Carolina Baruch Institute are examining how stormwater conveyances and control structures impact inputs of oxygen-demanding substances in coastal waters, measured as biochemical oxygen demand over a five-day period (BOD5). Samples were collected during rain events and dry periods from sites representing a variety of land uses and stormwater management practices.

Results: Researchers developed estimates of nonpoint source BOD5 values, as well as an empirical relationship between BOD5 and ultimate BOD, that can be used for improved oxygen TMDL modeling in coastal SC. These findings demonstrate the importance of managing episodic stormwater pollutant discharge, especially the particulate fraction in the first flush of runoff, from urbanized areas to mitigate DO impairment in downstream receiving waters.

Partners: Georgetown County Stormwater Management; Horry County Stormwater Management Program; University of South Carolina (USC); North Carolina State University (NCSU)

South Carolina Sea Grant Consortium Researchers Investigate Water Quality Impacts of Development in Tidal Creek Watersheds to Improve Land-Use Planning

Andrew Tweel, S.C. Department of Natural Resources

Denise Sanger, S.C. Department of Natural Resources

Recap: Research supported by the South Carolina Sea Grant Consortium revealed greater salinity, fecal coliform, and enterococcus fluctuations in areas of high development intensity.

Relevance: The rate of coastal population growth and associated development has increased rapidly along the South Carolina coast and ranks among the highest nationally. Impervious cover increases proportionately with development, and these surfaces contribute to increases in stormwater runoff. This runoff can alter coastal salinity regimes, lead to shifts in biological communities, and is associated with increases in fecal coliform and other contaminants. Coastal communities are responsible for developing and implementing stormwater management plans, but significant knowledge gaps remain as to watershed characteristics that are associated with the greatest impacts, and how these impacts vary within and between tidal creek systems.

Response: S.C. Sea Grant Consortium (Consortium) researchers at the South Carolina Department of Natural Resources are quantifying watershed characteristics associated with stormwater impacts, the spatial extent of such impacts, and how they may respond to predicted changes in climate and weather patterns. To achieve this, Consortium researchers are investigating how water quality following rain events varies along the length of tidal creek systems in areas with various types and intensity of development. Spatial analysis of candidate tidal creek systems was performed using a variety of factors like impervious cover, shellfish harvesting, soil permeability, and stormwater pond coverage. Four study systems were selected: Guerin, Seaside, Toomer, and Dupont-Wappoo Creeks. Salinity and weather data were collected from each site.

Results: Analysis of data from each site suggests greater salinity fluctuations in areas of high development intensity. Fecal coliform and enterococcus also followed this gradient. The Dupont-Wappoo system exhibits several signs of water quality degradation and is also the most densely developed system. Charleston-area watershed salinity gradients are primarily driven by development metrics, while watersheds in the Port Royal region exhibit salinity sensitivities that appear to be more driven by geographical metrics such as soil type.

Partners: Berkeley County Stormwater Management; Charleston County Stormwater Management Program; City of Charleston Department of Stormwater Management; Town of Mount Pleasant Stormwater Program; Charleston Waterkeeper; Clemson University Cooperative Extension; National Oceanic and Atmospheric Administration (US DOC, NOAA)

S.C. Sea Grant Consortium Researchers Analyze Hydrological and Economic Impacts to Coastal Community Access During Nuisance Flood Events

Daniel Hitchcock, Marzieh Motallebi, Amy Scaroni; Clemson University

Recap: S.C. Sea Grant consortium researchers are examining green infrastructure interventions to mitigate impacts of nuisance flooding on access to coastal areas.

Relevance: Coastal resilience research related to infrastructure along the Southeastern US is critically needed as extreme weather (e.g. hurricanes, flooding) increasingly impact our coastal communities and economies. This regional research effort will allow for transferability of results across and among various states with a positive impact for the region.

Response: S.C. Sea Grant Consortium researchers at Clemson University are working with coastal municipalities to identify areas where access is impacted by nuisance flooding and evaluating cost-effective green infrastructure interventions like natural land conservation and restoration of coastal wetlands, oyster reefs and beach dunes for mitigating flood risks in these locales.

Results: Researchers are assimilating a variety of data (economic, transportation, elevation, etc.) to map these “hot spots” in GIS. Economic data related to how access limitations or denials impact local businesses and residents is also being collected for North Carolina, South Carolina, and Georgia.

Partners: Stetson University; University of Georgia (UGA); University of North Carolina, Wilmington (UNCW); Georgetown County, S.C.; Pawley’s Island, S.C.; Debordieu Community Association, S.C.

WEATHER AND CLIMATE RESILIENCE

IMPACTS

S.C. Sea Grant Consortium Provides Expertise to Guide Charleston, S.C. All-Hazards Vulnerability and Risk Assessment

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: S.C. Sea Grant Consortium provided expert consultation and foundational data sets in flood hazard assessment and facilitated engagement with subject matter experts in earthquake vulnerability assessment at member institutions to inform an all-hazards vulnerability and risk assessment performed for the City of Charleston, S.C.

Relevance: Due to its geographic location and low relief, the City of Charleston is vulnerable to a wide range of environmental hazards, from sea-level rise and high-intensity rain events to major earthquakes. In order to incorporate these hazards into the city's planning and management, a vulnerability and risk assessment was conducted, which the city views as its best chance to unify all facets of its operations around mitigating these threats.

Response: S.C. Sea Grant Consortium staff worked with the consultants hired by the City of Charleston to ensure the highest quality data and methodologies were employed during the project. Consortium staff provided flood hazard data sets which were produced during previous initiatives and brought in experts at a member institution, the College of Charleston, to advise on the earthquake hazard for the area.

Results: A report detailing the results of the assessment was released by the City of Charleston on November 12, 2020 along with a presentation of findings to the City's Resiliency & Sustainability Advisory Committee on the same day. In addition to identifying vulnerabilities and risks, the report provides adaptation options and sets priorities for reducing those vulnerabilities and risks.

Partners: Charleston, S.C.; College of Charleston

S.C. Sea Grant Consortium and College of Charleston Provide Assessment of U.S. Department of Agriculture Foundational Dataset

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: An analysis was conducted to improve the utility of the foundational U.S. Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP), which is a vital resource for research professionals and resource managers across the country.

Relevance: The USDA NAIP Program is the authority on curating biennial aerial imagery for every state in the country, used as a foundational dataset by experts in every scientific discipline employing remote sensing techniques. Included with these data is a key supplemental file detailing the date, time, and coverage of each flight path during photo collection.

Response: A research team from the S.C. Sea Grant Consortium and the College of Charleston conducted an analysis to verify the alignment of the reported data with the ground conditions observed on the aerial images. The team used GIS software to model the position and angle of the sun during the reported time of photo collection and compared the shadows cast across the landscape to those observed on the NAIP images.

Results: The team concluded that the time zone reported was incorrect for several years of data, resulting in inaccurate application of the data for time-sensitive analyses. A report was generated and provided to USDA NAIP staff. Staff of USDA NAIP provided the report to their Geospatial Inspection teams in order to correct the issue.

Partners: College of Charleston

S.C. Sea Grant Consortium and College of Charleston Flood Modeling and Visualizations Enhance Community Resilience

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: S.C. Sea Grant Consortium co-developed resilience science and engagement products with several coastal communities in S.C. for use in their adaptation planning initiatives.

Relevance: The coastal S.C. region is highly vulnerable to tidal flooding and flooding from heavy rain. Municipalities in the region need specific local data to better understand under what conditions flooding occurs so they can plan and respond effectively.

Response: In Partnership with researchers at the College of Charleston's Lowcountry Hazards Center, S.C. Sea Grant Consortium staff developed tidal flood models and data visualization portals for three coastal communities (Town of Edisto Beach, Town of Edisto Island, and Town of Hilton Head Island). In response to requests from local administrators in each area, researchers obtained digital elevation models and mean higher high water (MHHW) tidal surfaces and generated simple "bathtub" flood models by uniformly elevating the tidal surface in 6-inch increments and extracting areas where the tide height exceeds ground elevation. Web mapping applications were developed for viewing the resulting flood maps and provided to stakeholders in each community.

Results: Maps and data viewers are being utilized by local municipalities as part of their resilience planning initiatives. The flood monitoring application received 21 submissions from residents of the Town of Edisto Beach in 2020 and remains an ongoing resource for the community.

Partners: Edisto Beach, S.C.; Edisto Island, S.C.; Hilton Head, S.C.; College of Charleston

S.C. Sea Grant Consortium and CISA Provide Coordination and Technical Assistance for Beaufort County Sea-Level Rise Task Force

Sarah Watson, S.C. Sea Grant Consortium and Carolinas Integrated Sciences and Assessments, University of S.C. and Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: Beaufort County, S.C. continues to develop a new Long-Term Resilience Plan and update its comprehensive plan with requested technical assistance from S.C. Sea Grant Consortium. The Consortium is drafting the resilience plan, facilitated in-person and virtual workshops to help shape recommendations, and provided feedback for applying recommendations to the 2021 comprehensive plan update.

Relevance: Beaufort County, S.C. is comprised of sea islands, barrier islands, and tidal creeks that extend far inland. It has substantial vulnerabilities to flooding and sea-level rise. As such, the county has worked with the Consortium since 2012 on sea-level rise planning. The Consortium developed, in Partnership with the Carolinas Integrated Sciences and Assessments, a sea-level rise action plan for the county in 2015. The recommendations from the plan were incorporated in the county's comprehensive plan. As the county revises the comprehensive plan, it wanted to highlight how sea-level rise planning could be further implemented and integrated.

Response: Consortium staff participated in and facilitated meetings, drafted a report, and provided expert guidance on how to incorporate sea-level rise projections into local codes and ordinances. Staff also used sea-level rise data layers developed during the City of Beaufort Flood Vulnerability Assessment to analyze the parcel impacts in Beaufort County, S.C. due to sea-level rise. The Consortium leveraged its longstanding relationship with the College of Charleston Lowcountry Hazards Center to perform the data processing of the analysis, as the demands were too great for the county to perform in-house.

Results: The county is developing a new Long-Term Resilience Plan that highlights specific steps the county can take to increase resilience throughout county policy. Municipalities that are serving on the task force can incorporate the recommendations and other work into their future planning work. Several key recommendations in the draft plan also have been woven throughout the draft comprehensive plan, which will go out for public comment in spring 2021. The county also is a core partner in a research grant application to the Adaptation Sciences grant Program through NOAA's Climate Program Office.

Partners: Beaufort County, S.C.; Carolina's Integrated Sciences and Assessment Center; College of Charleston

S.C. Sea Grant Consortium Assists Kiawah Conservancy in Obtaining \$172,758 in Grants for Coastal Resilience Projects

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston and Susan Lovelace, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium builds capacity within Kiawah Conservancy by providing staff time and expertise to obtain \$172,758 in grant funding for coastal resilience projects.

Relevance: Kiawah Island, like most barrier islands in South Carolina, is vulnerable to climate change impacts including sea-level rise, erosion, and coastal flooding. As is the case with other coastal communities, Kiawah Island must take steps to ensure their resilience to these impacts so that quality of life and community well-being can be maintained.

Response: S.C. Sea Grant Consortium (Consortium) partnered with Kiawah Conservancy to assist them in obtaining \$172,758 for two resilience projects. National Fish and Wildlife Foundation granted \$123,758 to conduct a series of engagement exercises to identify ecologically and socially suitable nature-based solutions and establish an implementation plan. Town of Kiawah Island granted \$49,000 to study fluctuations of the shallow groundwater table and characterize the vulnerability of marsh habitat to identify hazard mitigation options.

Results: Consortium staff provided data, maps, grant writing, and proposal management expertise, playing an essential role in obtaining \$172,758 in grant funds for the Kiawah Conservancy. By providing these resources, the Consortium built capacity within this organization to identify relevant coastal resilience project funds and to understand how to use scientific information to increase the strength of grant proposals. The Consortium's role in

both projects consists of supervising employees, facilitating meetings, and advising on analysis methods.

Partners: Kiawah Conservancy; Kiawah Island, S.C.

ACCOMPLISHMENTS

S.C. Sea Grant Consortium Partnership to Develop and Deliver High-Resolution Land Use/Land Cover Data Products for Coastal S.C.

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: Staff of the S.C. Sea Grant Consortium collaborated with the College of Charleston and National Oceanic and Atmospheric Administration's Coastal Change Analysis Program (C-CAP) team to develop the highest-resolution land cover data ever created for the coast of South Carolina in order to power environmental modeling in the state.

Relevance: Geospatial modeling, and flood hazard modeling in particular, in the coastal lowcountry of South Carolina requires high- resolution mapping products to perform accurately. Despite the need for those data, one of the most foundational base data sets for hazard modeling, land use/land cover, had never been made publicly available at a resolution fine enough for high-resolution mapping in the area.

Response: A collaboration was formed between the S.C. Sea Grant Consortium, the College of Charleston's Lowcountry Hazards Center (LHC), and the National Oceanic and Atmospheric Administration's Coastal Change Analysis Program (C-CAP) to develop and deliver the highest-resolution land use/land cover data products ever created for the coast of South Carolina. Using newly acquired software for the project and adapting techniques developed by the C-CAP team, staff at the Consortium and the College are developing one-meter resolution land cover data for the eight counties in the coastal zone of South Carolina.

Results: These data enhance the resolution of any prior product 30-fold and will be made available on NOAA's Digital Coast in the Fall of 2021. A supplemental analysis was requested from staff of the Consortium and LHC by The Post and Courier, the leading newspaper in Charleston, S.C., to measure changes in the area's tree canopy over the past several decades - with special attention to how this could affect flooding. Findings of the analysis were published December 12, 2020 as part of the newspaper's Rising Waters series.

Partners: College of Charleston; Office for Coastal Management (NOAA, NOS, OCM)

S.C. Sea Grant Consortium Initiates Long-Term Monitoring of the Groundwater Table in Coastal S.C.

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: With the importance of understanding characteristics of the groundwater table for both hazard mitigation and environmental health, the S.C. Sea Grant Consortium, alongside a team of experts, began a long-term monitoring study with the installation of a network of groundwater wells across a barrier island system.

Relevance: While much attention is paid to the flow and accumulation of surface water, little is known about the characteristics of the groundwater table and its influence on the plant, animal, and human communities in coastal areas. The depth and salinity of subsurface groundwater are major factors influencing both the health of coastal

ecosystems and flood conditions impacting human populations.

Response: Recognizing this gap in knowledge, the Town of Kiawah Island funded a collaborative research project led by experts from S.C. Sea Grant Consortium, Kiawah Conservancy, and the College of Charleston (CofC). The project funded graduate-level students from CofC to install 18 monitoring wells via a stratified sampling design created to sample groundwater conditions across different elevations soil types and locations on the island. Each well was equipped with continuous dataloggers measuring the depth of the groundwater table, with five wells additionally recording salinity.

Results: The National Fish and Wildlife Foundation awarded funds to the project team to conduct informed scenario planning, engaging with the local community to discuss green infrastructure and habitat restoration projects to be implemented. Data from this effort will play a major role in informing those discussions and future implementations on the island.

Partners: College of Charleston; Kiawah Island, S.C., Kiawah Conservancy

S.C. Sea Grant Consortium's New Tidal Monitoring Initiative Puts Local Data in the Hands of Local Communities

Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: A tidal monitoring initiative supported by the S.C. Sea Grant Consortium has resulted in seven new tide gauges installed along the state's coast, with an additional 40 planned for installation across coastal North and South Carolina in 2021.

Relevance: The low-lying coastal region of South Carolina is highly vulnerable to tidal flooding and has experienced repeated impacts from both extreme and chronic flooding over the last decade. The complexity of these tidal systems combined with the lack of widely distributed monitoring equipment has resulted in a lack of understanding of how to prepare for and respond to these events for local communities.

Response: Staff of the S.C. Sea Grant Consortium provided expert guidance and consultation to S.C. Beach Advocates and the American Shore and Beach Preservation Association to support the installation of tidal monitoring stations along the S.C. coast. The tide gauges continuously collect tide height data and were funded through a public-private Partnership where each municipality only had to provide \$500 of the \$2,500 total cost.

Results: Seven new tide gauges were installed in the state, with an additional seven installed in North Carolina, greatly increasing the coverage of tidal monitoring in the region. Local administrators from each municipality receiving a gauge participated in a monthly call to provide feedback on installation, lessons learned, and data usefulness-creating a coalition for the use of these new technologies at the local level that persists today. Additionally, a grant application supported by the Consortium was awarded in 2020 by the Southeast Coastal Ocean Observing Regional Association to expand the deployment of sensors to an additional 40 communities across coastal North and South Carolina in 2021.

Partners: College of Charleston; American Shore and Beach Preservation Association; S.C. Beach Advocates

S.C. Sea Grant Consortium Researchers Seek to Provide Real-Time Flood Conditions to Citizens so They Know When and Where to Avoid Driving When Roads Flood in the Charleston Region

Norman Levine and Emma Paz, College of Charleston

Recap: S.C. Sea Grant Consortium researchers are creating a map application to provide real-time flood conditions on roads to end-users Program focus areas: Weather and Climate Resilience

Relevance: Citizens in the coastal South Carolina region face an ever-growing struggle with understanding when and where tidally-induced and rainfall flooding are going to impact their daily routines.

Response: S.C. Sea Grant Consortium researchers at the College of Charleston propose to create a map application (M-App) to address this issue. Gauge station tidal heights, and current and predicted rainfall conditions and flood hazards will be incorporated into the product via a web-based interactive mapping portal. This will not only inform citizens across the region about the timing and location of flooding on a real-time basis, but it will also provide general information and education on potential surge and hurricane and long-term vulnerability problems.

Results: Researchers developed a database of modeled tidal flooding severity for every road in Charleston County, S.C., linking set intervals of tide height to corresponding flood intensity for each road segment. Additionally, the foundation for the application was designed and tested, allowing querying of environmental monitoring data from around the study area and displays the projected flood conditions in real-time to end users.

Partners: National Weather Service, Charleston, S.C. (US DOC, NOAA, NWS); Office for Coastal Management (NOAA, NOS, OCM)

S.C. Sea Grant Consortium and CISA Assist Town of Edisto Beach to Plan for Sea-Level Rise and Flooding Risks

Sarah Watson, S.C. Sea Grant Consortium and Carolinas Integrated Sciences and Assessments, University of S.C. and Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: S.C. Sea Grant Consortium resilience specialists engaged with residents of the Town of Edisto Beach, S.C. to plan for climate resilience.

Relevance: Edisto Island is a tiny and very low-lying barrier island that is already experiencing substantial impacts from flooding and sea-level rise, including routinely failing septic systems, persistent street flooding from tidal flooding and heavy rain, and corroding underground infrastructure. The S.C. Sea Grant Consortium was approached in February 2020 by Edisto Beach town leaders for assistance understanding future risks and impacts related to sea-level rise and flooding.

Response: The Consortium identified the opportunity to assist Carolinas Integrated Sciences and Assessments (CISA) with continuing their Vulnerability Consequences and Adaptation Planning Scenarios (VCAPS) process research as the town had not done any prior planning. Due to the pandemic, the workshops were postponed multiple times, finally occurring virtually in August and December 2020. The College of Charleston Lowcountry Hazards Center assisted by providing high-resolution bathtub model mapping and using various approaches to collect flooding data from residents.

Results: The team is developing a comprehensive report on the findings from the VCAPS sessions and additional analyses, with the goal of helping the Town of Edisto Beach identify ways it can reduce flooding in the short term. The team is anticipating public engagement on the plan to begin in July 2021, with the final report delivered at the end of Summer 2021. The initial lessons learned from this community also resulted in an application to the Adaptation Sciences Request for Proposals by NOAA's Climate Program Office to study groundwater impacts, adaptation pathways, and adaptive capacity in a nearby county.

Partners: College of Charleston; Edisto Beach, S.C.; Carolina's Integrated Sciences and Assessment Center

S.C. Sea Grant Consortium Workshop at 2020 Social Coast Forum Focuses on Trauma Awareness in Risk Communication

Sarah Watson, S.C. Sea Grant Consortium and Carolinas Integrated Sciences and Assessments, University of S.C.

Recap: S.C. Sea Grant Consortium held a workshop at the 2020 Social Coast Forum to discuss how to incorporate trauma awareness into climate and risk communication.

Relevance: As the public gets more experience with flooding and climate disasters, they are more likely to have experienced trauma with them, either firsthand or vicariously. Climate and risk communicators have experiences where they inadvertently trigger these traumas by communicating about future risks.

Response: In Partnership with Faith Kearns, California Institute for Water Resources, University of California Agriculture and Natural Resources, and Susi Moser with Susanne Moser Research and Consulting, S.C. Sea Grant Consortium held a workshop at the 2020 Social Coast Forum in Charleston about exploring how to make risk communication trauma aware.

Results: The 40-minute workshop explored what trauma is, the causes of post-traumatic stress, the term "trauma informed" and its meaning, and how to shift communication and engagement about risks and hazards to be presented in less triggering ways to those already traumatized by those same risks and hazards. Participants then discussed personal involvement of various communication situations that could have been handled differently. Nearly 50 people attended the session and left contact information for inclusion on future discussions.

Partners: Susanne Moser Research and Consulting (SMRC); California Institute for Water Resources

S.C. Sea Grant Consortium Submits Final Report for NOAA Regional Coastal Resilience Grant

Sarah Watson, S.C. Sea Grant Consortium and Carolinas Integrated Sciences and Assessments, University of S.C.

Recap: The S.C. Sea Grant Consortium received a NOAA Regional Coastal Resilience Grant in 2016 on behalf of the Charleston Resilience Network to develop a parcel-level flood model and conduct neighborhood-level engagement activities to ground-truth data and educate residents about flood risks. The flood methodology developed through the College of Charleston and the Consortium has been transferred to other parts of coastal S.C. The Consortium submitted the final report in October 2020.

Relevance: The Charleston region is highly vulnerable to tidal flooding and flooding from heavy rain. Municipalities

in the region need specific local data to better understand under what conditions flooding occurs so they can plan and respond effectively.

Response: As part of a NOAA Regional Coastal Resilience Grant and on behalf of the Charleston Resilience Network, S.C. Sea Grant Consortium and College of Charleston developed a flood modeling methodology over several years. The Consortium ground-truthed the methodology using a variety of methods, including community member participation at four engagement events because residents have much more on-the-ground knowledge of how and when flooding occurs in their neighborhoods.

Results: The research team submitted the final report, which contains write-ups of all research conducted under this grant, in October 2020.

Partners: Carolina's Integrated Sciences and Assessment Center; Charleston Resilience Network; College of Charleston; The Citadel

S.C. Sea Grant Consortium Assists College of Charleston Class to Develop Vulnerability Assessments for Two Areas in Charleston County

Sarah Watson, S.C. Sea Grant Consortium and Carolinas Integrated Sciences and Assessments, University of S.C.

Recap: During the Fall 2020 semester, a graduate course was developed and taught at College of Charleston on applied coastal resilience. Students conducted a vulnerability assessment for their study area and offered recommendations through the engagement of stakeholders and local governments, researching and analyzing data, and gaining real world experience in the field.

Relevance: The College of Charleston approached S.C. Sea Grant Consortium in March 2020 to develop and teach a graduate level course on applied coastal resilience. The primary goal of the class was to give graduate students in the Master of Environmental and Sustainability Studies Program real-world experiences.

Response: Through a Partnership with Charleston County, two study areas were identified: James Island and the northern part of Charleston County. Eight students worked with the communities, under the guidance of the Coastal Climate and Resilience specialist, to develop a basic vulnerability assessment and recommendations for next steps in building resilience. The Coastal Resilience specialist and others with the College of Charleston Lowcountry Hazards Center provided technical assistance with GIS tools and various analyses for the reports. Municipal and county staff were involved throughout the process, giving students the opportunity to learn more about jobs and post-graduate professions.

Results: Over the course of the semester, students broadened their skillsets and delivered both a presentation and a report of the vulnerability assessment and recommendations. The final reports will be shared with the communities in March 2021.

Partners: Charleston County, S.C.; Charleston, S.C.; College of Charleston; Awendaw, S.C.; McClellanville, S.C.; Town of James Island

S.C. Sea Grant Consortium Researchers Examine Sea-Level Rise Risks to Vulnerable Populations

Mostafa Batouli, The Citadel

Recap: South Carolina Sea Grant Consortium researchers conducted a comprehensive literature review and analyzed data in an effort to understand sea level rise impacts on socioeconomically vulnerable populations.

Relevance: At the local, county, and state levels, recurrent flooding exacerbated by sea level rise poses a significant threat to the function and performance of coastal infrastructure systems. Local governments and infrastructure agencies in South Carolina are already planning adaptation measures such as building seawalls, rethinking roads, and planting vegetation to absorb.

Understanding the evolution of social vulnerability in the long-term enables decision makers to anticipate the future needs of vulnerable populations and design methods of responding to their needs.

Response: Researchers conducted a comprehensive review of climate and sea level rise resilience literature as they relate to vulnerable populations and socioeconomic equity, and analyzed socioeconomic data from the census. Data related to mean sea level rise, tidal variations, and rainfall in South Carolina was also collected.

Results: As a result of these efforts, researchers created a comprehensive list of traits that make an individual or a community vulnerable to sea level rise, and have begun modeling the impacts of sea level rise on vulnerable populations.

Partners: University of South Carolina (USC)

Consortium Creates Climate Change Impacts Module for Community Nursing Students

Susan Lovelace, S.C. Sea Grant Consortium, Sarah Watson, S.C. Sea Grant Consortium and Carolinas Integrated Sciences and Assessments, University of S.C. and Landon Knapp, S.C. Sea Grant Consortium and Lowcountry Hazards Center, College of Charleston

Recap: At the request of faculty the Consortium extension specialists created an asynchronous climate change impacts education module for use by faculty in training 80 students at the MUSC College of Nursing.

Relevance: Nurses working in communities are at the ground level of climate change health impacts. However, the university medical faculty that teach them have had little training on climate change and impacts. College of Nursing faculty from the Medical University of South Carolina (MUSC) reached out to Consortium staff for assistance in providing community nursing students with basic information in their practicum population health class.

Response: Extension specialists developed an asynchronous learning module on climate change and impacts for faculty to use in the MUSC population health class. Responding to the educational needs and professional challenges for community nurses they created the module to meet learning objectives that included knowledge of climate change impacts in the Southeast U.S., use of sea level rise and risk tools and ability to assess public health impacts from flood to water, wastewater and public health infrastructure.

Results: MUSC had 80 students complete the module during the fall 2020 semester. The module included educational materials and two hands-on activities, one of which was a 5-hour field study to investigate where and

how flooding occurs and the other to use the Consortium's Susceptibility of Public Health Impacts from Flooded Water, Wastewater and Public Health Infrastructure guide to assess a location. The faculty identified the need to increase their own competence in this area.

Partners: Medical University of South Carolina (MUSC)

SUSTAINABLE FISHERIES AND AQUACULTURE

IMPACTS

S.C. Sea Grant Consortium Provides Technical Assistance to Oyster Mariculture Industry, Enabling Sustained Growth

Graham Gaines, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium technology transfer efforts have resulted in the propagation of South Carolina-based seed stock to supply the rapidly emerging oyster-farming industry in South Carolina and throughout the South Atlantic region. The total economic benefit attributed to the S.C. Sea Grant Consortium is \$535,203.

Relevance: In April 2014, South Carolina introduced a moratorium on importing oyster seed. Growers had to seek new seed sources and develop capacity to produce seed within S.C. to continue industry growth. A grower expressed interest in expanding nursery production and building a hatchery to meet the needs of all S.C. growers. The Program aimed to build an industry that is resilient to environmental and regulatory changes by providing a reliable, in-state oyster seed source.

Response: The S.C. Sea Grant Consortium (Consortium) provided continued technical expertise on hatchery and nursery system design and standard operating procedures to allow the facility to optimize production. Beginning in 2014, the Consortium, in Partnership with industry, launched a broodstock Program with the goal of producing triploid oyster seed using only South Carolina broodstock. Approximately 50% of the seed used by growers in South Carolina in 2020 came from the hatchery built on Consortium technical assistance.

Results: According to SCDNR, dockside value of oyster mariculture production in 2020 was \$728,295. While hatchery technical assistance was completed in 2018, the industry would not have grown without Consortium support. Dockside oyster mariculture value attributed to the Consortium is \$182,074. Using conservative prices for restaurant- and seafood-market retail and assuming sales were split across restaurants and seafood markets, a value added economic benefit of \$353,129 is estimated for a total economic benefit of \$535,203.

Partners: Lady's Island Oysters

S.C. Sea Grant Consortium Gains Sustainability Commitments from McClellanville Working Watermen

Graham Gaines, S.C. Sea Grant Consortium

Recap: The McClellanville Watermen's Association (MWA) have committed to a sustainable and ethical approach toward commercial fishing.

Relevance: Fishermen in McClellanville, and elsewhere in the state, possess vast knowledge of fisheries habitat and ecosystems. They are aware their actions have direct, short-term, and long-term impacts on these ecosystems. Seafood consumers are increasingly requesting the need for sustainability and transparency to be incorporated into fisheries practices. Additionally, marine resource agencies apply pressure and laws for the industry to abide by. This

creates a need for fishermen within common fisheries and geographies to collectively agree on ways to improve upon their sustainable practices.

Response: Consortium specialists worked with the Town of McClellanville and the MWA to determine how the McClellanville fishing community can best express their commitment toward sustainability. While the fishers themselves have always been intentionally mindful of their ecological impact, it was determined that a collective set of guidelines will be an appropriate supplement to the direction that the MWA is taking - to ensure the industry and fisheries are sustained for future generations. Consortium specialists researched and spoke with similar Programs across the country that have made similar commitments, and through meetings and drafts, eventually decided on a way forward.

Results: In December 2020, the watermen signed off on the “McClellanville Watermen Association’s Collective Commitments to Sustainability and Ethical Fishing Practice.” The document highlights, among other things, the watermen’s commitment to: stewardship of coastal waters and fishing grounds, legal and ethical practices in seafood harvesting and sales, and ethical and non-discriminatory labor practices. Resulting from these commitments, new opportunities related to capturing traditional ecological knowledge and citizen science projects are expected.

Partners: McClellanville Community Foundation; McClellanville Watermen’s Association

S.C. Sea Grant Consortium Builds Capacity for the South Carolina Seafood Alliance

Graham Gaines, S.C. Sea Grant Consortium

Recap: The South Carolina Seafood Alliance has better positioned itself as an influential professional association for the commercial fishing industry in the Southeast, poised to promote sustainable seafood options and improve the industry’s existing infrastructure and operations.

Relevance: The South Carolina commercial fishing industry has decreased dramatically in recent years, which reduces the state’s capacity to provide locally-sourced seafood. The drivers behind this decline are complex, but fishermen and academics often allude to an increasingly complex regulatory environment, low-cost seafood imports and non-local seafood sources, a lack of generational skills and assets transfer, and a devaluing of the profession. Without an organized effort, coastal economies and coastal heritage are negatively impacted, and food security is threatened.

Response: The Consortium’s Living Marine Resource specialist assessed the needs of the commercial fishing industry to understand its status and priorities. It was determined that a lack of organization was preventing grants and public funds earmarked for food security and sustainable fisheries from finding its way to the South Carolina fishing industry. The Consortium worked with the South Carolina Seafood Alliance’s previous director to determine how to better position the organization to receive funds and better advocate on behalf of the industry. The Partnership also explored how to take advantage of parallel efforts at the federal level.

Results: The South Carolina Seafood Alliance has been registered as a 501(c)(3), and is now registered with federal Programs and websites to receive funding directly. A new executive director with a background in sustainable seafood has been hired, and the Board of Directors is tackling new challenges. Longtime Partnerships between the Consortium, the Alliance, the South Carolina Shellfish Growers Association, and the S.C. Department of Agriculture have been strengthened, while new Partnerships are being formed. A new website and outreach plan have been

developed. Paperwork has been digitized and a new approach to finances was organized. Finally, a new strategic plan has been developed.

Partners: South Carolina Seafood Alliance; South Carolina Department of Agriculture

S.C. Sea Grant Consortium Assists with Securing Sustainable Seafood Grants to Non-Profit Fisheries Organizations

Graham Gaines, S.C. Sea Grant Consortium

Recap: The Consortium played an integral role in the award of three grants to two local non-profit organizations - McClellanville Community Foundation (\$12,000) and the South Carolina Seafood Alliance (\$37,500)-which will collectively support the resilience of the commercial fisheries industry in South Carolina.

Relevance: Obtaining funds to support fisheries industry-wide organizational efforts is challenging, as all efforts and resources are channeled toward keeping their independent operations afloat. Many businesses and organizations lack expertise in grant writing or relevant connections to nationwide networks that support grassroots efforts. By stepping in to connect the industry to private and public Partners that offer funding assistance, commercial fisheries objectives related to sustainability and resilience can be supported. This was of particular importance during the COVID pandemic, which crippled the seafood industry's ability to support anything beyond essential functions.

Response: The Consortium offered grant-writing assistance to multiple fisheries organizations in 2020. Two organizations were receptive to the Partnership and collaborated on various grant opportunities. The Consortium helped the McClellanville Community Foundation (MCF) apply for funding from Catch Together, a non-profit organization that supports financing for sustainable fisheries. The Consortium also helped obtain funding on behalf of the South Carolina Seafood Alliance, from Catch Together as well as from the USDA's Local Food Promotion Program.

Results: MCF was awarded \$12,000 from Catch Together's COVID Relief grant opportunity. The funds supported education, outreach, and fundraising activities of McClellanville's working watermen, who hope these efforts will aid industry recovery from the loss of revenue incurred during COVID-19 due to restaurant closures. The watermen now have a consumer-facing image to leverage their branding. The Seafood Alliance used their \$12,000 award from MCF to support staff salary because seafood industries could not afford the Alliance's membership dues since restaurants were closed. The Alliance's \$25,500 award from USDA's Local Food Promotion Program is being used to assess the infrastructure and operational needs of S.C.'s seafood industry, so key priorities can be addressed through Partnerships and funding opportunities.

Partners: South Carolina Department of Agriculture; US Department of Agriculture (USDA); South Carolina Seafood Alliance; McClellanville Community Foundation; Catch Together

S.C. Sea Grant Consortium Gets Increased Payout Rates for S.C.-Grown Oysters from U.S. Department of Agriculture Disaster Assistance Program

Graham Gaines and Matt Gorstein, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium (Consortium) extension specialists engage with U.S. Department of Agriculture

(USDA) Farm Service Agency (FSA) office in Columbia, S.C. to update risk reduction products.

Relevance: Currently in South Carolina, the only federal crop insurance coverage available to the state's oyster growers is through a non-specialized USDA Program called the Non-Insured Crop Disaster Assistance Program (NAP). This is not always an optimal choice for the state's growers for reasons including high premiums and low payout rates not commiserate with typical wholesale prices received by growers.

Response: Consortium extension specialists engaged with the USDA Farm Service Agency office in S.C. to discuss oyster aquaculture risk reduction products, including Non-Insured Crop Disaster Assistance Program coverage. It was discussed how payout rates in S.C. (\$0.50 for 3" oysters; \$0.33 for 2-3" oysters) were not necessarily reflective of the marketplace for S.C.-grown oysters. The Consortium obtained data from the S.C. Department of Natural Resources documenting oyster mariculture production and wholesale revenue to show that, in 2019, the average wholesale price received by S.C. growers was \$0.84 per oyster. This finding was shared with the FSA office.

Results: The USDA FSA raised its NAP payout rates to \$0.88 for 3" oysters grown in SC and \$0.79 for 2-3" oysters grown in S.C.

Partners: US Department of Agriculture (USDA)

ACCOMPLISHMENTS

S.C. Sea Grant Consortium Scientists Continue to Explore Social Carrying Capacity of Expanding Oyster Mariculture Along the Coast

Bill Norman, Lauren Duffy, Jeffrey Hallo, Laura Jodice; Clemson University

Recap: Overall, a preponderance of support exists for oyster farming in South Carolina, particularly when it is well-managed and does not interfere with boating.

Relevance: As a result of the promotion of local seafood and growing familiarity with shellfish products such as oysters and clams, the demand and willingness to pay a higher price for farmed shellfish has increased, especially in coastal tourism destinations on the South Carolina coast. Recent research suggests S.C. residents and tourists are broadly supportive of existing mariculture, but there is little understanding of support for expansion of oyster mariculture, which will include highly visible infrastructure.

Response: S.C. Sea Grant researchers based at Clemson University are examining social carrying capacity among residents and waterway users who will be most directly impacted by expansion. They worked with an advisory group comprised of shellfish managers, commercial growers, local officials, business owners, and recreational users to develop a survey designed to reach stakeholder groups in Charleston and Beaufort counties in coastal South Carolina. Eighty interviews were conducted, including social value data (e.g., aesthetic, recreational, ecological, land-use, cultural) to be digitized onto S.C. Department of Health and Environmental Control mariculture permit maps.

Results: Overall, a preponderance of support exists for oyster farming, particularly when it is well-managed and does not interfere with boating. Oysters and oyster farming are often supported as culturally appropriate and as a mechanism for economic growth, local food production, and community vitality. The general public seems relatively under-informed, and in cases misinformed, about oyster farming; most concerns expressed about it are often related to this lack of knowledge. The research team developed a draft survey instrument based on input and

feedback from the project advisory committee, a review of issues from both supportive and oppositional advocacy groups, a review of both scientific and professional literature, previous project outcomes. Static, Moving and Virtual Reality (VR) visual stimulations were developed for use with the survey, which will be completed in the next year.

Partners: Charleston Oyster Company; Lady's Island Oyster Farm; South Carolina Department of Natural Resources (SC DNR); South Carolina Department of Health and Environmental Control (SC DHEC); The Nature Conservancy (TNC); Charleston Fish Finder; Harry Hampton Memorial Wildlife Fund; Great Underwriting Solutions; Hilton Head Sportfishing Club ; ACE Basin National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); South Carolina Coastal Conservation League ; Reel Chance Charters; East Coast Shellfish Growers Association

S.C. Sea Grant Researchers are Utilizing Local Charleston, South Carolina Craft Brewery By-Products to Fill Nutritional Gaps in Sustainable Fish Feeds for Juvenile Red Drum

Aaron Watson, Fabio Casu, Mike Denson; S.C. Department of Natural Resources

Recap: Consortium researchers are investigating the feasibility of developing a viable by-product from brewery spent grain material for use in high quality fish feeds. This would represent a sustainable use, potential additional revenue stream for breweries, and would assist the domestic aquaculture industry's growth by providing locally sourced, cost effective ingredients to either replace fishmeal or meet specific nutritional requirements.

Relevance: As domestic and world populations continue to increase, so does the demand for healthy, sustainable fish protein. Aquaculture has expanded exponentially to fill the growing divide between supply and demand; however, a great deal of aquaculture production still relies on feed ingredients for protein and lipid sources from wild stocks in the form of fishmeal and fish oil, while the costs of feed can represent more than 50% of the total cost of producing market size fish. Spent grains from craft breweries represent a currently underutilized potential source of nutrition for fish feeds.

Response: S.C. Sea Grant researchers are examining the potential use of spent grains from craft breweries in the Charleston, South Carolina area as viable ingredients in fish feeds for juvenile red drum. They have partnered with three local craft breweries, collected monthly samples from each brewery, and begun evaluating the material itself for composition and determining digestibility and tolerance in juvenile red drum.

Results: The initial analyses demonstrate a high level of consistency both over time within a single brewery and over time between breweries regarding all analyzed components. This is a very encouraging result as it means that by-product from breweries can not only be combined without significantly changing the composition, but it also means the material can easily be incorporated into down-stream uses such as animal feeds relatively easily. Another result that has been encouraging for the continued exploration of brewery by-product as an ingredient is the ease of collecting, drying, and processing the material. No significant or expensive equipment has been required in any steps of developing a fine powdered material ideal for analyses and inclusion in feeds.

Partners: Holy City Brewing; Low Tide Brewing; Tradesman Brewing Company

S.C. Sea Grant Consortium Researchers Look for Pathways to Produce Omega-3 Fats for Use in Aquaculture Facilities

Mark Blenner, Clemson University

Recap: Low nitrogen environments are more suitable for enzyme activity to produce omega 3 fats for use in aquaculture outfits.

Relevance: As developing countries around the world continue to raise their standard of living, and as the world population continues to rise, there is an increasing demand on the global food supply. However, overfishing of natural waters endangers the ocean and river ecosystems, threatening the security of this important food source. For the aquaculture industry to continue to grow and meet the global demands for nutritious fish, a new and sustainable source of omega-3 fatty acids will have to be developed.

Response: Researchers examined utilizing agricultural products, such as rendered animal fats and plant oils as sustainable feedstocks for the production of food, chemicals, and materials. To achieve this, researchers proposed engineering a biocatalyst that is able to efficiently convert liquid and solid fats into higher value products, such as omega-3 fats, for aquaculture production.

Results: Enzyme efficiency was tested and shown to be more prevalent in low nitrogen environments, leading to higher production of omega- 3 fats.

Partners: U.S. Department of Agriculture (USDA); Delaware Sea Grant

S.C. Sea Grant Consortium Researchers Developing Spotted Seatrout Model Designed for Enhanced Resource Management

Tanya Darden, S.C. Department of Natural Resources

Recap: South Carolina Sea Grant Consortium researchers began designing a spotted seatrout model that more accurately reflects its life history to guide resource managers with decision-making in stock enhancement.

Relevance: Spotted seatrout are especially vulnerable to winter kills, which occur at least once each decade and appear to be the major factor associated with changes in population abundance. Little information is available to guide the role of stock enhancement in facilitating recovery of spotted seatrout populations following these events. Stocking offspring from a small number of broodstock may reduce genetic diversity and effective population size, both of which are important for the long-term adaptability of a population.

Response: Researchers are developing a demographic and genetic model they hope will provide resource managers in South Carolina with a stock enhancement tool to guide spotted seatrout conservation and restoration following winter cold events.

Results: Consortium researchers have collected genetic data from 650 spotted seatrout samples, calculated spawn and hatchery effective population size, and begun to modify an existing genetic model for spotted seatrout life history.

S.C. Sea Grant Consortium Researchers Developing Tripletail Fish Culture Techniques for Co-Production in Shellfish Ponds

Jason Broach, S.C. Department of Natural Resources

Recap: S.C. Sea Grant Consortium researchers are establishing tripletail fish culture techniques in an effort to demonstrate feasibility of co-producing them in shellfish ponds as a way to diversify production.

Relevance: Tripletail are a highly valuable marine finfish for seafood markets, but require extensive research to develop methods for successful aquaculture of the species. With a fast-growing juvenile phase, limiting wild-caught supply, and retail value up to \$23 per pound, commercial aquaculture of tripletail could certainly be a lucrative opportunity for aquaculture producers in South Carolina to diversify their production models, particularly in conjunction with shellfish production ponds.

Response: Successful demonstration of the feasibility to house and spawn mature broodfish and co-produce marketable tripletail along with shellfish in extensive settings may positively influence producers to incorporate tripletail into their business plans. Researchers set out to define culture techniques for spawning tripletail and extensive larval and juvenile culture in seawater ponds with oyster crops and disseminate effective spawning methods to South Carolina aquaculture producers.

Results: In an effort to establish at least one natural spawning population of tripletail in a recirculating aquaculture system (RAS) and record spawning frequency and quality over time, tripletail have been collected by fisherman and staff at the South Carolina Department of Natural Resources (SCDNR).

S.C. Sea Grant Consortium Researchers Developing Non-Lethal Tool to Aid in Cobia Population Stock Assessments and Restoration

Tanya Darden, S.C. Department of Natural Resources

Recap: South Carolina Sea Grant Consortium researchers began building a nonlethal tool to sequence cobia genomes in an effort to begin restoration efforts for inshore spawning populations.

Relevance: Cobia is a species of concern in SC due to heavy fishing pressure on the inshore spawning population segment over the last two decades, and the state of South Carolina has implemented management actions, including harvest reduction and stock enhancement within inshore waters.

Response: Researchers proposed using next generation sequencing technologies, which are more efficient in screening entire genomes, in an effort to develop a new tool for sex identification of cobia. The development of a non-lethal, minimally invasive tool for sex identification will substantially aid in assessing the restoration of the inshore population segment by providing easy access to wild population data, as well as increasing hatchery production efficiency.

Results: Researchers began sequencing cobia samples for DNA sex identification of the individuals. Sampling will continue in an effort to develop a non-lethal tool that can be used in stock enhancements and assessments, and sustainable aquaculture.

S.C. Sea Grant Consortium Scientists Develop Novel Fish Aging Techniques

Joe Quattro, University of South Carolina; Michelle Passerotti, University of South Carolina; Joe Ballenger, S.C. Department of Natural Resources

Recap: S.C. Sea Grant Consortium research led to development of novel methodologies for predicting both annual and daily ages from otoliths of red snapper, and predicting age to 17 years in sand tiger sharks. Additionally, a novel equipment modification for use in scanning very small otoliths for use with near infrared spectroscopy (NIRS) was developed.

Relevance: The ability to quickly detect changes in age and growth trajectories of fish is a key to successfully managing them. Current methods are time-consuming, expensive, and make real-time management more challenging. In addition, climate change presents new and dynamic challenges to the management of migratory fish species, potentially altering life cycles and habitat ranges. Developing novel aging methods in fish species is important to every stakeholder and end-user of fisheries resources, as it will improve the regulatory process and enhance management.

Response: S.C. Sea Grant Consortium researchers at the University of South Carolina and the S.C. Department of Natural Resources are estimating fish ages using near infrared spectroscopy (NIRS) and on red snapper otoliths, a bony structure of the inner ear, and sand tiger shark vertebrae. Over 1200 otoliths from Gulf of Mexico and Atlantic red snapper populations were scanned using NIRS, and comparisons to traditionally-aged otoliths confirm this methodology to be both faster and highly accurate for annual and daily aging. This methodology has also successfully been used for predicting age to 17 years in sand tiger sharks.

Results: Consortium researchers expect time and cost savings associated with the NIRS method to be substantial, as NIRS data collection and age prediction for otoliths in NIRS models could be accomplished by a single person in much less time compared to traditional methods.

NOAA Fisheries is actively vetting this methodology for integration into age production methodologies nationwide. Regional management council recommendations have been made recently in assessment workshops to pursue use of NIRS for improving the scope and timing of production ageing for managed species.

Partners: Bruker Corporation; Florida Fish and Wildlife Conservation Commission (FL FWC); Alaska Fisheries Science Center (US DOC, NOAA, NMFS); Southeast Fisheries Science Center (US DOC, NOAA, NMFS, SEFSC)

Consortium Creates South Atlantic Red Snapper Research Program

Susan Lovelace, Graham Gaines, Susannah Sheldon, and Ryan Bradley, S.C. Sea Grant Consortium

Recap: After engaging a steering committee and running a competition, the Consortium was awarded nearly \$1.5 Million dollars for the development of a great Red Snapper Count in the South Atlantic.

Relevance: The allowable catch limit of red snapper from South Atlantic federal waters has varied substantially, in some years being zero. The allocations for harvest are set using a formula based on historic and recent average landings. Uncertainty in the stock assessment inhibits the ability to set an allowable catch limit that can be effectively monitored. While latest assessments suggest that catch limits should be lowered, a majority of fishermen expressed frustration.

Response: With the intent of improving uncertainty estimates in generating absolute abundance estimates, the

South Carolina Sea Grant Consortium (Consortium) worked with regional Sea Grant Programs to synthesize regional research needs into prioritized research objectives for the RFP and ran the competition. Letters of Intent were evaluated for projects that best met the objectives and were feasible within the budget and timeline of the Program.

Results: The Consortium engaged a steering committee comprised people from Sea Grant, NMF, state agencies, and industry. After considering priority research needs, the priority questions were developed. The SC ensured that the RFP was widely distributed and reviewed the Letters of Intent. The goal is to fund one or more projects to count the number of red snapper in the South Atlantic to provide a better understanding of the stock and improved the science upon which catch limits are based.

Partners: University of North Carolina, Wilmington (UNCW); Georgia Sea Grant; University of Georgia (UGA); Florida Sea Grant/UF; Georgia Department of Natural Resources (GA DNR); North Carolina Department of Environment and Natural Resources (NC DENR); S.C. Department of Natural Resources; Florida Fish and Wildlife Conservation Commission; South Atlantic Fishery Management Council (SAFMC); Abundant Seafood; Texas A&M University (TAMU); Mississippi-Alabama Sea Grant Consortium; Hulls Seafood

S.C. Sea Grant Consortium Contributes to Clemson-Led Project on Socioeconomic Research for Mariculture Industry

Matt Gorstein and Graham Gaines, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium extension specialists provide expertise in successfully implementing shellfish mariculture socioeconomic research project to investigate both consumer and producer.

Relevance: The South Carolina shellfish aquaculture industry, specifically oysters, continues to grow. As this industry is still relatively young, characterizing consumer preferences for S.C. aquaculture products is important for identifying emerging opportunities and/or challenges. Moreover, characterizing the industry from a producer perspective is also vital for tracking industry progress and being proactive in addressing potential barriers to sustainable industry growth.

Response: Researchers from Clemson University received funding from the U.S. Department of Agriculture to assess consumer perceptions of South Carolina aquaculture products, produce a South Carolina shellfish aquaculture industry situation and outlook report, and estimate the total economic contribution of the industry. Consortium extension specialists provided expertise and assistance related to survey design and development of outreach products.

Results: According to consumers, the most important product attributes they consider when purchasing aquaculture products are taste, quality/freshness, and cost. Sixty-five percent of survey respondents indicated that they would be willing to pay a price premium for aquaculture products produced in South Carolina (34% premium for clams, 43% for oysters, and 29% for shrimp), and 76% of respondents living in South Carolina coastal counties indicated that they support off-bottom oyster production.

Partners: Clemson University

S.C. Sea Grant Consortium Provides COVID-19 Support for the Seafood Industry

Graham Gaines, S.C. Sea Grant Consortium

Recap: Throughout 2020, the Consortium assisted seafood producers to navigate the challenges posed by COVID-19, by promoting local seafood outlets during a time that access to fresh seafood was difficult and unsafe. The Consortium also directed seafood producers to relief resources and developed plans to build the resiliency of the seafood supply chain to future disruptions.

Relevance: Early impacts of COVID-19 was particularly challenging for the seafood industry, as South Carolina seafood producers lean heavily on restaurants as outlets for their products. 58% of shrimp and 62% of oysters are estimated to be consumed at restaurants, and one study in the Lowcountry estimated 90.7% of “on the half-shell” single oysters were consumed in S.C. restaurants. Keeping the industry’s doors open and preventing job loss therefore became a priority.

Response: Specialists supported the industry by communicating with seafood producers in S.C. to see who was able to stay open and continue to safely sell products, and maintained communications so the information was updated and shared by a trusted source. Specialists then participated in networking groups, webinars, and briefings to understand federal Programs available to food producers. Finally, specialists engaged in one- on-one conversations with producers to assess impact and determine a corrective action for building resiliency, which resulted in funding for 2021 and beyond.

Results: The Consortium published a regularly-updated webpage dedicated to local seafood markets that were open during the pandemic, and included safety information, hours of operation, and contacts. Over 30 establishments, sorted by county, benefited from this exposure. Direct support was provided to seven producers to navigate federal Programs under the CARES Act, while information was shared with 64 fishermen and 13 aquaculturists. A subcommittee was developed to identify beneficial projects to increase resilience of the mariculture industry. A proposal was developed and \$67,500 was awarded to address supply chain vulnerabilities, aquaculture literacy, and development of direct marketing strategies.

Partners: South Carolina Seafood Alliance; South Carolina Shellfish Growers Association

S.C. Sea Grant Consortium Develops Rapid Response RFP

Graham Gaines and April Turner, S.C. Sea Grant Consortium

Recap: The Consortium developed and was awarded a \$99,500 Direct Marketing Support project for the shellfish aquaculture and nature- based tourism industry, aimed at providing both immediate and long-term solutions to the impacts of COVID-19, all of which will begin in 2021. The “Rapid Response” activities address a vulnerable supply chain using a three-tiered approach: understanding consumer preferences, identifying regulatory obstacles, and direct support of online marketing efforts by S.C. seafood producers.

Relevance: COVID-19 caused many challenges for seafood businesses in South Carolina. Farmed shellfish is reliant on restaurants as an outlet for their product, with more than 65% of growers’ inventory going directly to restaurants. Soft-shell crab producers, the other major mariculture industry in S.C., suffered an 80% loss in 2020 sales. The pandemic has highlighted a major vulnerability in the local seafood supply chain, and presented an opportunity to learn how to improve that supply chain. To keep businesses open, prevent job losses, and boost the supply of sustainable seafood, determining best practices for alternative sales were needed.

Response: The Consortium worked with industry members to develop “Rapid Response” opportunities that

would address the problems identified above. These solutions included: (a) understanding the potential for direct marketing of S.C. seafood products through a Study Group Partnership with the Clemson Marketing MBA Program; (b) developing a regulatory guide for retail or direct-to-consumer sales for seafood producers; (c) an aquaculture literacy campaign to promote the science behind year-round oyster sales; and (d) social media training courses for aquaculture producers. Included in this Rapid Response package were funds to support nature-based tourism.

Results: A total of \$99,500 was awarded to the Consortium for a Direct Marketing Support project for the shellfish aquaculture and nature-based tourism industries, aimed at providing both immediate and long-term solutions to the impacts of COVID-19.

S.C. Sea Grant Consortium Develops Red Snapper RFP

Susan Lovelace, Graham Gaines, Susannah Sheldon, and Ryan Bradley, S.C. Sea Grant Consortium

Recap: National Sea Grant Office and National Marine Fisheries Service awarded the Consortium \$75,000 to administer a \$1.5M research competition investigating abundance of the South Atlantic stocks of Red Snapper (*Lutjanus campechanus*). The Consortium identified and worked with a steering committee of marine fisheries experts to determine the contents and scope of a Request for Proposals to better understand the stock status of this economically and ecologically important species.

Relevance: Red snapper is a popular target of sportfishers and the commercial fishing industry throughout the South Atlantic. Historical overharvesting resulted in a depleted population in the South Atlantic, but under current management measures the population is recovering. Some controversy surrounds the current stock assessment for South Atlantic red snapper, particularly with regard to accuracy of population estimates. Given this, the Consortium was tasked with overseeing and implementing a research competition to support a sub-award to generate an absolute abundance estimate for the entire South Atlantic red snapper stock.

Response: The Consortium established a steering committee of 18 marine fisheries professionals, including fisheries scientists, policy makers, fishermen, and extension agents to prepare the RFP, which was based on congressional language, scientific data, and stakeholder input. Communications teams helped in the distribution of the RFP.

Results: The committee fielded and reviewed Letters of Intent, and internal staff at the Consortium communicated with potential submitters on the submission details and guidelines. The funds were awarded in 2021, and the project is currently underway.

Partners: Florida Sea Grant; Georgia Sea Grant; National Sea Grant College Program (US DOC, NOAA, OAR, NSGCP); North Carolina Sea Grant; Abundant Seafood; South Atlantic Fishery Management Council (SAFMC); National Marine Fisheries Service (US DOC, NOAA, NMFS); Georgia Department of Natural Resources (GA DNR); North Carolina Department of Environment and Natural Resources (NC DENR); South Carolina Department of Natural Resources (SC DNR); Hulls Seafood

S.C. Sea Grant Consortium Contributes to Greater Amberjack Research Needs

Graham Gaines and Susan Lovelace, S.C. Sea Grant Consortium

Recap: The Consortium contributed to the 2020-2023 Gulf of Mexico and South Atlantic Greater Amberjack Research Program Visioning project - an effort to plan, implement and document a multi-regional, multi-year Greater Amberjack (*Seriola dumerili*) research Program through a cooperative agreement with the National Sea Grant Office (NSGO) and the National Marine Fisheries Service (NMFS). Greater Amberjack is an important recreational and commercial species in the Gulf of Mexico and South Atlantic regions.

Relevance: The goal of the Greater Amberjack Research Program was to develop additional data sources, assessment approaches, and knowledge to improve agency- and agency-independent estimates of the abundance of Greater Amberjack throughout the species' range. To adequately pursue a research Program of this scale, a visioning phase was implemented to solicit stakeholder data input and understand the key research needs.

Response: Consortium staff helped develop a survey instrument, reviewed existing research and policies, and interviewed Greater Amberjack fishermen, including both sport and commercial fishermen. A total of six interviews were held which ascertained attitudes and motivations towards amberjack fishing, a characterization of industry perceptions towards the stock, and management of the fishery.

Results: Consortium staff also served on the steering committee for the research project, which took the lessons learned from the visioning phase to inform the development of the RFP.

Partners: Florida Sea Grant; Georgia Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium; North Carolina Sea Grant

S.C. Sea Grant Consortium Develops Oyster Production Surveys for "Industry Status and Outlook" Report

Graham Gaines and Matt Gorstein, S.C. Sea Grant Consortium

Recap: In Partnership with Clemson University economists, the Consortium collected data to be used for a state-wide Shellfish Industry Economic Impact report. The report will detail the extent of shellfish mariculture production in South Carolina, and the impact the industry has on the state economy and employment.

Relevance: Shellfish mariculture is relatively new in South Carolina, and a comprehensive assessment of its extent and impact has yet to be conducted. By understanding the financial components and economic impact of shellfish mariculture, an accurate and transparent method potentially can be used for legislative and management purposes. The financial sector can then make more informed decisions on lending risk and investment opportunities.

Response: Consortium staff conducted in-person field visits and collected data on the seven existing floating gear oyster farms in the state. Results: Data collected included: total investments; employment; operational costs; revenue; production; marketing information; and challenges and opportunities for the industry. The collection of this data will be processed using advanced statistical and analytical software, which will be used for the report to be finalized in 2021.

Partners: Clemson University; South Carolina Shellfish Growers Association

S.C. Sea Grant Consortium Outlines Concept for Aquaculture Research and Training Study and Return on Investment Analysis

Matt Gorstein and Graham Gaines, S.C. Sea Grant Consortium

Recap: Concept is outlined to conduct shellfish aquaculture research and training Program feasibility study and return on investment (ROI) analysis.

Relevance: The growth of the shellfish aquaculture industry in the last few years has led to an increased interest in developing research and development to optimize sustainable shellfish production and survival rates and workforce training Programs to adequately train industry entrants in gear handling, shellfish science, and business planning.

Response: The Consortium identified an interested partner to conduct the ROI analysis. This assessment will utilize input-output modeling techniques to estimate the potential return on investment of constructing and operating a shellfish aquaculture research and training Program in South Carolina as measured through an economic impact analysis. Next steps include stakeholder meetings, data collection, implementation of the ROI analysis, and full feasibility study.

Results: Interested stakeholders from Consortium member institutions, technical colleges, and regulatory agencies were identified and invited to participate in a working group to define the scope and steer the assumptions of the ROI analysis.

Partners: University of South Carolina

SCIENTIFIC LITERACY AND WORKFORCE DEVELOPMENT

IMPACTS

S.C. Sea Grant Consortium Graduates First Cohort of Educators from Palmetto Environmental Education Certification Program

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: Thirteen formal and nonformal educators become the first certified environmental educators in the state through the Palmetto Environmental Education Certification Program.

Relevance: In 2013, the S.C. Sea Grant Consortium disseminated a state-wide needs assessment to educators to gauge interest in the creation of an environmental education (EE) certification Program. More than 90% of the 120 responses were in favor, citing benefits such as “professionalizing the field” and “increased networking opportunities”. Following the needs assessment, two focus groups were hosted and a steering committee established to oversee the development of the certification’s content, format, and requirements.

Response: The state’s first EE certification Program, Palmetto Environmental Education Certification (PEEC), officially launched in 2018 and welcomed its first cohort of 18 formal and nonformal educators. Thirteen educators successfully completed the requirements of the two- year Program, including attendance at four workshop trainings, completion of eight online modules, 90 hours of electives, and a capstone project. In August 2020, these 13 educators officially graduated, becoming the first to obtain PEEC certification.

Results: Graduating the 2020 cohort of 13 educators established PEEC as the state’s first successful EE certification Program. This milestone positioned the Program to receive financial stability, such as a \$23,000 sponsorship from the Champions of the Environment Program. In addition, Partnerships evolved, including the official endorsement and recognition of PEEC as the official EE provider by both the Environmental Education Association of S.C. and the North American Association for Environmental Education. The economic benefit of this cohort of the PEEC Program is \$23,705.

Partners: Clemson University; Francis Marion University; Charleston County Parks and Recreation Commission; South Carolina Department of Natural Resources (SC DNR); Lynches River County Park; Kalmia Gardens; College of Charleston; Morehead Planetarium

S.C. Sea Grant Consortium Palmetto Environmental Education Certification Program Becomes Renewal Course Provider by S.C. Dept. of Education

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: The Palmetto Environmental Education Certification Program became an approved Renewal Course Provider for 120 credit hours by the S.C. Department of Education.

Relevance: S.C. formal educators must obtain 120 renewal credits every five years to renew the teaching certificate (S.C. State Department of Education [SDE] <https://ed.sc.gov/educators/certification/professional/>). Renewal credits

can be attained through attendance at workshops/trainings relevant to their field of teaching and receipt of documentation verifying the hours. Finding opportunities and keeping track of renewal hours are time consuming and costly; to assist, the SDE compiles a list of pre-approved Renewal Course Providers that provides the date/topic of training and renewal credit hours.

Response: In 2018, the S.C. Sea Grant Consortium (Consortium) led a team to launch the Palmetto Environmental Education Certification (PEEC) Program - the state's first environmental education certification Program. Because of the time commitment of the two-year Program, the Consortium applied for and was approved by the SDE for PEEC to be listed as an official "Renewal Course Provider" for 120 renewal credit hours. Both August 2020 and 2022 graduates of the Program are eligible to claim these hours.

Results: Because the PEEC Program is pre-approved for 120 renewal credit hours, any formal educator successfully completing the certification can satisfy all of the hours needed to re-up their teaching certificate for one five-year period. Not only does this decrease the amount of time educators need to find and attend Programs offering renewal credits, but it also is more economically efficient with one registration cost (\$450) covering all hours needed for recertification.

Partners: Morehead Planetarium; College of Charleston; Francis Marion University; South Carolina Department of Natural Resources (SC DNR); Charleston County Parks and Recreation Commission

S.C. Sea Grant Consortium Palmetto Environmental Education Certification Program Launches Diversity Scholarship Program

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: Diversity Scholarship Program officially launched in 2020 and awarded four scholarships for educators to enroll in the Palmetto Environmental Education Certification Program.

Relevance: In 2013, the S.C. Sea Grant Consortium (Consortium) disseminated a state-wide needs assessment to educators to gauge interest in developing an environmental education certification Program. More than 90% of the 120 responses were in favor; therefore, a steering committee was established to oversee the development of the certification's content, format, and requirements. To begin, the steering committee developed a title (Palmetto Environmental Education Certification [PEEC]), vision, mission, and objectives that served as the foundation for the entire Program.

Response: One of the PEEC objectives is to "Train educators who are representative of the diverse communities and regions within the state." Based on 2019 U.S. Census Bureau data, S.C. has 37.4% of the population who identify as a person of color; however, there is still a dearth of diversity within the fields of environmental sciences and environmental education/interpretation. To address this objective, the Consortium secured funding from the Spaulding-Paolozzi Foundation and the North American Association for Environmental Education to establish a Diversity Scholarship Program. This opportunity was made available in July 2020 to cover the registration cost for the 2020 - 2022 PEEC session.

Results: Using a scoring rubric and selection committee, four individuals (one nonformal and three formal) from Beaufort, Richland, Kershaw, and Dorchester counties were selected as winners of the PEEC Diversity Scholarship. The selection criteria included racial diversity (personal or target audience) and financial need. The estimated value of this impact exceeds \$2,400 since it covers the PEEC registration and allows for the five-year recertification of a

formal educator's teaching certificate.

Partners: Charleston County Parks and Recreation Commission; Morehead Planetarium; Lynches River County Park; South Carolina Department of Natural Resources (SC DNR); College of Charleston

ACCOMPLISHMENTS

S.C. Sea Grant Consortium Secures \$29,600 in Funding to Expand Palmetto Environmental Education Certification Program

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium secured \$29,600 in funding to create a Diversity Scholarship, support instructors and administrative assistance, and provide additional educational materials for the Palmetto Environmental Education Certification Program.

Relevance: In 2013, the S.C. Sea Grant Consortium (Consortium) disseminated a state-wide needs assessment to gauge educators' interest in the development of an environmental education certification Program. More than 90% of the 120 responses were in favor, citing benefits such as "professionalizing the field" and "increased networking opportunities." Following the official launch of the Palmetto Environmental Education Certification (PEEC) Program in 2018, additional financial support was necessary to support operating costs, Program expansion, and long-term sustainability.

Response: The Consortium successfully secured \$29,600 from state and private foundations, including Harry Hampton Memorial Wildlife Fund (\$5,000), North American Association for Environmental Education (\$1,600), and the S.C. Department of Health and Environmental Control's Champions of the Environment (\$23,000). In addition, the 2020 - 2021 yearly fundraising campaign coordinated by the Environmental Education Association of South Carolina identified PEEC as one Program that would be supported by money raised (the campaign is still ongoing).

Results: With this additional funding, the PEEC Program has a) established a Diversity Scholarship Program and awarded four scholarships, b) provided 10 teaching stipends for the 2020 - 2022 PEEC instructor team, c) extended contractual support for an administrative assistant, and d) provided for additional supplies and resources to the PEEC 2020 - 2022 cohort.

Partners: Harry Hampton Memorial Wildlife Fund; Environmental Education Association of South Carolina; North American Association for Environmental Education; South Carolina Department of Health and Environmental Control (SC DHEC)

S.C. Sea Grant Consortium Curriculum Connection Serves as Model for Coastwatch Magazine's Educational Supplement, Coastwatch Classroom

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: The format and content of Curriculum Connection, the education supplement to the S.C. Sea Grant Consortium's *Coastal Heritage* magazine, serves as the model for the creation of Coastwatch Classroom.

Relevance: The S.C. Sea Grant Consortium (Consortium) produces its flagship quarterly magazine, *Coastal Heritage*,

which is offered free- of-charge as a hard copy or online version. Since its establishment in 1982, *Coastal Heritage* has produced over 150 issues covering a range of topics, including climate change impacts, invasive species, Gullah-Geechee culture, and the connection between arts and science. Many of the featured topics of Coastal Heritage align with S.C. State Standards in science, social studies, and occasionally mathematics.

Response: In spring 2000, Curriculum Connection was developed as an online, educational supplement to each *Coastal Heritage* issue using the content to address S.C. State Standards, highlight activities and resources, and provide guidance on field-based experiences.

Results: Due to the long-term success of Coastal Heritage and Curriculum Connection, North Carolina Sea Grant developed a companion educational piece for their agency's flagship magazine, *Coastwatch*. The new educational supplement, Coastwatch Classroom, launched in fall 2020, and was structured based upon the format and content of Curriculum Connection.

Partners: North Carolina Sea Grant

S.C. Sea Grant Consortium Pivots During COVID-19, Delivers 100% of Professional Development Workshops through Online Platforms

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium adapts 100% of face-to-face professional development to online instruction during COVID-19.

Relevance: In March 2020, S.C. public school districts, private schools, and nonformal institutions across the state closed and shifted to online learning platforms in response to the COVID-19 pandemic. For most educators, the abrupt switch from face-to-face instruction to online teaching resulted in numerous challenges, including a) locating quality online student resources, b) becoming adept using technologies for online learning, and c) meeting district- and state-wide requirements for maintaining teaching certification (e.g., renewal credits).

Response: The S.C. Sea Grant Consortium pivoted from conducting in-person professional development (PD) to hosting these opportunities via ZOOM®. Science content was repackaged in the form of live and previously-recorded videos, virtual field trips, small group discussions, demonstrations, and presentations. For most of the PD opportunities, a workshop package was mailed out in advance and included materials so participants could follow along with demonstrations, teacher resources, and student activities/lessons. Continuing education credits also were offered.

Results: Between June 2020 and February 2021, 100% of the previously scheduled, in-person PD opportunities were adapted to an online platform. These Programs included: Educator Science Cafe® Series, From Seeds to Shoreline®, BioDiscovery, Teachers on the Estuary, and Palmetto Environmental Education Certification Program. In total, 193 formal and nonformal educators attended from across the state; approximately 30% of attendees represented inland counties, a record-high metric based on the past five years. The economic impact totals \$37,132.

Partners: Charleston County Parks and Recreation Commission ; Clemson University Cooperative Extension; ACE Basin National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); North Inlet-Winyah Bay National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); South Carolina Department of Natural Resources (SC DNR); Patriots Point Naval & Maritime Museum

S.C. Sea Grant Consortium Adapts From Seeds to Shoreline® K-12 Program Model for Community-Based Restoration

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: Support from the National Oceanic and Atmospheric Administration National Marine Fisheries Service restoration grant expanded the From Seeds to Shoreline® K-12 model to include community-level, volunteer-based restoration and monitoring.

Relevance: The S.C. Sea Grant Consortium (Consortium) leads the coordination of the From Seeds to Shoreline® (S2S) salt marsh restoration Program, which engages K-12 students in cultivating and transplanting *Sporobolus alterniflorus* (formerly *Spartina alterniflora*) to designated areas of coastline. During this year-long restoration effort, students learn about salt marsh ecology, understand critical ecosystem benefits, and investigate threats to this habitat. Since its inception in 2010, the educational model and cultivation methodology of S2S have been established as best practices.

Response: In 2019, the S.C. Department of Natural Resources was awarded funding (the Consortium was a sub-awardee) from the National Oceanic and Atmospheric Administration National Marine Fisheries Service to engage community volunteers with both Eastern oyster (*Crassostrea virginica*) and *S. alterniflorus* restoration efforts at 13 Charleston, S.C. locations. The Consortium, using the previously established S2S model, coordinated community volunteers by engaging them in the four main restoration and data collection steps of *S. alterniflorus*: seed collection, germination, cultivation, and transplanting.

Results: During this reporting period, more 95 volunteers participated in collecting over 800,000 *S. alterniflorus* seeds at seven locations around the Charleston area. In addition, a platform was created on the Aneccdata® open-source, citizen-science app for volunteers to collect and report their data.

Partners: Clemson University Cooperative Extension; South Carolina Department of Natural Resources (SC DNR); National Marine Fisheries Service (US DOC, NOAA, NMFS)

S.C. Sea Grant Consortium Launches New Educational Resources and Opportunities in Response to COVID-19 Pandemic

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: To meet the shifting needs of educators during the COVID-19 pandemic, the S.C. Sea Grant Consortium (Consortium) developed four new online educational resources and opportunities.

Relevance: In March 2020, S.C. public school districts, private schools, and nonformal institutions across the state closed and shifted to online learning platforms in response to the COVID-19 pandemic. For most educators, the abrupt switch from face-to-face instruction to online teaching resulted in numerous challenges, including a) locating quality online student resources, b) becoming adept using technologies for online learning, and c) meeting district- and state-wide requirements for maintaining teaching certificates (e.g., renewal credits).

Response: To meet the needs of online learners, the Consortium developed the following resources and opportunities:

- Facebook Live Educator Help Line: Weekly series demonstrating science activities based on the Ocean Literacy

Essential Principles (OLEPs).

- My Ocean Science Journals for elementary-, middle-, and high-school students: Includes writing prompts for K-12 students based on the OLEPs.
- From Seeds to Shoreline® Video: Provides an overview of the project and Recaps the 2019 - 2020 school year.
- Quarantivia: Educator networking opportunity to learn about environmental topics in S.C. using a trivia format.
Results: The Consortium developed four new online resources to continue engaging educators and students.

Partners: Patriots Point Naval & Maritime Museum; Environmental Education Association of South Carolina; South Carolina Marine Educators Association; College of Charleston; S.C. Department of Natural Resources; Clemson University Cooperative Extension

S.C. Sea Grant Consortium Develops and Adopts Agency-Wide Diversity Plan

Elizabeth Bell and Marlena Davis, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium Board of Directors formally approves agency-wide Diversity Plan and actions have improved staff training, increased access to education, and improved diversity among advisory committees.

Relevance: Increasing diversity among staff members, stakeholders, and end-users continues to challenge not only the S.C. Sea Grant Consortium (Consortium) but geosciences-based organizations across the country. Along with increasing diversity, ensuring that Programs, resources, and opportunities foster inclusivity and are equitable adds important layers for consideration and implementation. The statistics have been and continue to be consistently low regarding diversity among career geoscientists. End users of scientific information for personal and community decision-making are often not reflective of the larger community.

Response: In June 2020 the Consortium, led by the former executive director and in collaboration with the agency's human resources manager and marine education specialist, reached out to staff for input on topics to be addressed in a formal Diversity Plan. Those responses were then categorized based on common themes, assigned an anticipated cost range, and an estimated timeframe for completion. Some categories included scheduling quarterly staff diversity trainings, increasing bilingual efforts, and diversifying advisory boards.

Results: The draft Diversity Plan was presented to the Consortium's Program Advisory Board in fall 2020 for suggestions and feedback. Shortly thereafter a revised Diversity Plan was presented to the Consortium's Board of Directors in September 2020 and was formally adopted at that time. A staff diversity statement draft has been crafted, a Diversity Scholarship established, one staff diversity training provided, and Extension advisory committee membership surpassed an initial 10% diversity threshold.

Partners: Clemson University; Coastal Carolina University (CCU); Medical University of South Carolina (MUSC); University of South Carolina (USC); The Citadel; College of Charleston; South Carolina Department of Natural Resources (SC DNR); South Carolina African American Heritage Foundation; South Carolina State University (SCSU); National Centers for Coastal Ocean Science (US DOC, NOAA, NOS, NCCOS); Office for Coastal Management (NOAA, NOS, OCM); Gullah/Geechee Cultural Heritage Corridor

S.C. Sea Grant Consortium Coastal Economics Specialist Gives Guest Lectures at Consortium Member Institutions

Matt Gorstein, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium (Consortium) Coastal Economics specialist gives guest lectures in Consortium member institution classes on topics related to ecosystem service valuation, South Carolina's blue economy, and how economics and social science techniques can be used to answer environmental questions.

Relevance: In an era of climate change and frequently occurring coastal hazards, addressing complex environmental issues with interdisciplinary science has become increasingly important. This involves the marriage of socioeconomic research with existing natural science research, including a recognition of the need for sustainable uses of coastal and ocean resource to sustain important economic activity, and the further acknowledgment of ecosystem service values in coastal zone management decision making. Ecosystem services refer to the benefits that humans receive from healthy functioning ecosystems; and while their values are often overlooked when making policy decisions, they are important to track.

Response: Consortium Coastal Economics Specialist Matt Gorstein gave three guest lectures to an ecosystem service valuation graduate class at Clemson University; an environmental studies graduate class at the College of Charleston; and a marine policy undergraduate class at the University of South Carolina. These guest lectures also served as an opportunity to share information on student fellowship and other funding opportunities and continue collaborating relationships with Consortium researchers.

Results: Students at member institutions were better informed about the role of the Consortium in the state and region and opportunities available to them at various career stages.

Partners: Clemson University; University of South Carolina; College of Charleston; College of Charleston MES Program

S.C. Sea Grant Consortium Website Continues to be a Significant Source of Science-Based Information

Susan Ferris Hill and Crystal Narayana, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium website is a source of science-based information for decision-makers and the public to help them make wise choices regarding coastal natural resource conservation and sustainability. In FY20-21, the website received 86,975 page views, a 21.7% increase from FY19-20.

Recap: The S.C. Sea Grant Consortium website is a source of science-based information for decision-makers and the public to help them make wise choices regarding coastal natural resource conservation and sustainability. In FY20-21, the website received 86,975 page views, a 21.7% increase from FY19-20.

Relevance: Decision-makers and the public should be informed about the coastal and marine environment and related community issues, and the S.C. Sea Grant Consortium (Consortium) website continues to be a significant source of this information. The website also gives the users a better understanding of Consortium funded research, education, and outreach Programs.

Response: The Communications staff maintains the Consortium's website (www.scseagrant.org) and updates the

content regularly with input from extension, education, administration, and outreach Partners. This includes writing news articles, research project updates, and information about ongoing outreach projects.

Results: The website received 86,975 page views, a 21.7% increase from FY19-20. Top publications (views):

- *Coastal Heritage*: Carolina's Gold Coast, the Culture of Rice and Slavery (5,930)
- *Coastal Heritage*: Carolina Diarist, the Broken World of Mary Chesnut (2,597)
- Stranded Horseshoe Crabs (2,241)
- *Coastal Heritage*: Emancipation Day, the Freed People of Port Royal (1,457)
- *Coastal Heritage*: Rise and Fall and Rise, South Carolina's Maritime History (1,403)
- *Coastal Heritage*: Communities Under Water, Lessons Learned from Extreme Floods (1,288)

S.C. Sea Grant Consortium's Publications Win Three Prestigious Awards

Susan Ferris Hill, Crystal Narayana, Matt Gorstein, and Roger Drouin, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium won three prestigious awards from the Society for Technical Communication-Carolina Chapter, APEX, and the South Carolina State Library.

Relevance: Recognition by communications professionals and librarians from the Southeast region and the State of South Carolina is one metric by which success is measured. Acknowledgment that publications are relevant, interesting, well-researched, and provide significant information to the public confirms the Consortium's public service role is successful.

Response: The Consortium regularly submits publications to various award competitions. The primary contributors to these three publications are staff in the communications, extension, education, and administration departments, as well as university and federal agency Partners.

Results: The S.C. Sea Grant Consortium won three prestigious awards for three publications. *Coastal Heritage*, the agency's flagship magazine, won a Distinguished Award from the Society for Technical Communication-Carolina Chapter and an APEX Award of Excellence in the Magazines and Journals category. The publication, *Assessing South Carolina's Ocean Economy*, won a Notable State Document Award from the South Carolina State Library.

S.C. Sea Grant Consortium Researchers Evaluate Effectiveness of a Science Outreach Program in Increasing Awareness and Interest in Marine and Climate Science

Recap: S.C. Sea Grant researchers' evaluation of a musical theater and science outreach Program demonstrated increased interest among elementary students, teachers, and university students in incorporating science in their career and teaching choices.

Relevance: The next generations will face new challenges related to the effects of climate change on the planet. Humans are connected to the ocean in many ways, including relying on resources from the ocean but also influencing the oceans through their actions. Ocean literacy is essential in empowering individuals to make informed and responsible decisions related to marine resources and ocean sustainability, but is rarely taught in schools not along the coast and many children in upstate South Carolina have never been to the coast. Clemson

University researchers teamed with Educational Entertainment, LLC to present a musical theater and science outreach Program called “Something Very Fishy” to K-5 students in the Upstate, some of whom have never experienced an ocean up close.

Response: S.C. Sea Grant Consortium researchers are evaluating the effectiveness of the “Something Very Fishy” exhibit to change attitudes and behaviors of those who participate and/or attend the performance. With the assistance of the educational staff of the SC Aquarium, Clemson student docents were trained to present hands-on science lesson plans for elementary classrooms. The docents worked with elementary school teachers in public, public Title I, and private schools to teach ocean literacy through virtual dives and live-animal experiments.

Results: Approximately 1200 children and 40 teachers from 15 attended the performance and exhibit. Students, teachers, and undergraduate docent surveys demonstrated an increase in STEM career interest among students, greater intention in teaching marine and climate literacy among teachers, and a stronger desire to choose a career involving science communications among docents.

Partners: Educational Entertainment, LLC; Temple University; South Carolina Aquarium

S.C. Sea Grant Consortium’s Communications and Education Team Creates 10 Publications for K-12 Virtual Learners and Teachers

Elizabeth Bell, S.C. Sea Grant Consortium

Recap: In response to the closure of schools and nonformal education institutions during the COVID-19 pandemic, S.C. Sea Grant Consortium’s Communications and Education Team created a 10-week set of Ocean Science Journals for elementary, middle, and high school grade bands and seven educator Lesson Plans for various grade levels.

Relevance: In March 2020, S.C. public school districts, private schools, and nonformal institutions across the state closed and shifted to online learning platforms in response to the COVID-19 pandemic. For most educators, the abrupt switch from face-to-face instruction to online teaching resulted in numerous challenges including locating quality online student resources.

Response: S.C. Sea Grant Consortium’s Communications and Education Team created a 10-week set of Ocean Science Journals for elementary, middle, and high school grade bands. Each week, one Ocean Literacy Essential Principle (OLEP) is highlighted with a fact page, writing prompt, and a supplemental activity. The Team also created seven educator Lesson Plans with activities for various grade levels based on OLEP, State of South Carolina Education Standards, and Next Generation Science Standards.

S.C. Sea Grant Consortium Fosters Student Support Through Internships, Fellowships, and Research Opportunities

Susannah Sheldon, S.C. Sea Grant Consortium

Recap: The Consortium continues to substantially contribute to workforce development through internships, fellowships, and research opportunities.

Relevance: Supporting undergraduate and graduate students and early career professionals leads to an informed, engaged, and well-trained workforce.

Response: The S.C. Sea Grant Consortium is involved in several initiatives that support education and professional development for these individuals. Fifty-nine Knauss fellows have been selected from South Carolina since 1984, and 20 Coastal Management fellows from South Carolina have been placed with various state agencies nationally since 1997. In addition, the Consortium Partners with the S.C. Space Grant Consortium to support the annual Kathryn D. Sullivan Earth and Marine Science Fellowship, designed to increase the number of highly trained earth and marine scientists and to enable graduate students to conduct NASA- and NOAA-related Earth/marine science research.

Results: In 2020, S.C. Sea Grant supported 12 undergraduates, 22 master's-level students, and 21 Ph.D. students in conjunction with Consortium-funded research, projects, and fellowships. Of these, 21 were new to Sea Grant support and 34 were continuing to receive support. One of the graduate students was a Sea Grant extension intern for the Consortium. Four Sea Grant-nominated students were selected for the Knauss fellowship and one for the Sullivan award. Sea Grant student support has improved ocean and coastal literacy among university students and early professionals and encouraged their success in securing coastal and marine-related employment.

Partners: NASA South Carolina Space Grant Consortium; Office for Coastal Management (NOAA, NOS, OCM)