SC Sea Grant Consortium – FY14-15 Impacts and Accomplishments

Hazard Resilience in Coastal Communities

IMPACTS

SC Sea Grant monitors the efficacy of beach nourishment
PI: Michael Slattery, SC Sea Grant Consortium

Relevance: The beaches along the Grand Strand portion of South Carolina have 50 year contracts with the US Army Corps of Engineers to complete periodic renourishment in order to maintain beach access to millions of annual visitors and the local community.

Response: Starting in 2008 the Coastal Processes Extension Specialist has been responsible (via MOU funding) for annual monitoring of the Reach I (North Myrtle Beach) and Reach III (Surfside Beach/Garden City) portions of the Grand Strand Nourishment project (last cycle completed in 2008-2009). This covers 16 miles of project area (25 miles total). The estimated return period for nourishment was modeled to be 5-8 years. Annual reports based on analysis of the monitoring are submitted to the funding agencies.

Results: Analysis of beach change from 2014 monitoring indicated that Reach I and Reach III beaches had met the official trigger point (25% of the project length meeting the beach width requirement). Based on the report, the Grand Strand communities and the Army Corps of Engineers began the process of initiating the next renourishment for this section of South Carolina, currently scheduled to take place from 2016-2017 for the three reaches. The early estimates are that costs will be near $27,000,000 for completing nourishment.

Recap: Based on monitoring, analysis, and a report from the S.C. Sea Grant Consortium, the Grand Strand communities and the US Army Corps of Engineers initiated the steps towards a $27 million dollar renourishment project covering just over 25 miles of beach.

ACCOMPLISHMENTS

Wind and rain resistant design for coastal cross-laminated timber buildings
PI: Weichiang Pang

Relevance: High winds and water intrusion can cause substantial damage to coastal South Carolina buildings. Cross-laminated timber (CLT) is an emergent building system that has a

history in Europe and Canada; however, little is known about its performance characteristics in a humid subtropical climate such as South Carolina's. Engineers need to know how to design for the unique wind loads and architects need to be familiar with cladding design issues specific to CLT.

Response: S.C. Sea Grant researchers at Clemson University tested a method which engineers can use to determine the design wind loads for a particular CLT structure. The investigation involved a series of wind tunnel studies on scale models of CLT buildings to gather data on surface wind pressures and overall wind forces. Full-scale testing will be performed to evaluate the efficacy of the described 'best practice' for CLT cladding design.

Results: S.C. Sea Grant researchers successfully developed 3D printing methods and procedures, preliminary testing of new panel configurations, and developed supplemental software and hardware needed to perform wind tunnel testing. Test panels were printed to represent the cross laminated timber product in a scale model. Methods for development of models and printing parameters were established. The preliminary testing of new panel configurations demonstrated that the new method of collecting data allows for the collection of data directly without having to devise a relational equation. Software and hardware development provided needed updates to the Clemson University Wind Test Load Facility, and additional software was updated to facilitate the acquisition of data. In addition, a test plan has been developed to perform the full-scale water intrusion testing on a 30' x 40' low-rise building.

Recap: While it has history in Canada and Europe, cross-laminated timber (CLT) is being tested by S.C. Sea Grant researchers at Clemson University as a new, eco-friendly building system in a humid subtropical climate. New 3D printing methods were developed for this effort and used to print test models for a scale model, allowing more rapid collection of data.

Observational and Modeling Studies Benefit Management and Selection of Borrow Sites for Beach Nourishment in South Carolina

Kevin Xu and Ansley Wren, Coastal Carolina University

Relevance: South Carolina has adopted beach nourishment as its predominant strategy for addressing adverse effects of coastal erosion on its beaches. Efficient and low-impact use of coastal sand resources is important to the sustainability of future nourishment programs state-

wide, as well as to the management of sediment resources regionally. Indeed, few studies have been done for reliably predicting borrow pit infill rates and sediment composition based on expected borrow area placement and design.

Response: S.C. Sea Grant researchers at Coastal Carolina University, in partnership with the private sector firm Olsen and Associates, collected hydrodynamic and sediment transport data, as well as seabed elevation data, at borrow and reference sites and used these data to establish, calibrate, and validate hydrodynamic and sediment transport models to study borrow area infilling processes following dredging sand for nourishment purposes.

Results: Sediment analyses indicate that the seabeds of most ebb tidal deltas are composed mainly of well-sorted sand, and dredging impacts are mainly on grain size and carbonate content. Initial measurements of surficial sediment at the borrow site post-dredging showed it was finer and had lower organic content than pre-dredging. The site had restored to pre-dredging levels within six months post-dredge. Several sediment transport models were run and validated, and meteorological and oceanographic data were processed for inclusion in the Regional Ocean Modeling System (ROMS) model, which was refined to enhance the decision-making capabilities of end-users. Very little mud accumulation was found in the borrow site for beach nourishment, allowing the site in this case to be used in future nourishment projects.

Recap: An understanding of how borrow pits infill based on hydrodynamic and sediment transport data and Regional Ocean Modeling System (ROMS) enhancement can inform the decision-making processes of the U.S. Army Corps of Engineers, the Bureau of Ocean Energy Management , SC DHEC Ocean and Coastal Resource Management, and coastal communities state-wide. Presuming no future infill, borrow sites with little mud accumulation can be used for multiple nourishment projects.

SC Sea Grant Consortium and SC DHEC-OCRM partner to update the South Carolina Guide to Beachfront Property

PI: Michael Slattery and Elizabeth Fly, SC Sea Grant Consortium

Relevance: South Carolina has a rapidly growing coastal population, and with this increase in population comes the need to better inform residents regarding the risks related to property ownership along the coast.

Response: Starting in 2012, Sea Grant worked with the SC Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management (OCRM) to develop a publication to provide guidance for beachfront homeowners about; coastal processes, related problems that arise such as damage by storms, renovation of coastal properties and services available to homeowners.

Results: The South Carolina Guide to Beachfront Property was published as an online adobe file for residents and visitors to access if they are looking to purchase or currently own beachfront property in South Carolina. It can be found at http://www.scseagrant.org/pdf_files/SC-Guide-to-Beachfront-Property.pdf.

Recap: The SC Sea Grant Consortium and the SC DHEC OCRM created *The South Carolina Guide to Beachfront Property* to inform current and potential coastal homeowners and landowners regarding laws, regulations and insurance issues that accompany ownership of beachfront properties in South Carolina.

Blue Crab Fishermen Engage in Citizen Science to Identify Ways to Adapt to Changing Climate

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: Beaufort County crabbers were impacted by several years of drought beginning in 2002. This has led crab fishermen to seek information about how their activities will be influenced by changes in climatic conditions.

Response: The South Carolina Sea Grant Consortium, Carolinas Integrated Sciences and Assessments, and the Social and Environmental Research Institute have partnered with blue crab fishermen, scientists, and natural resource managers to characterize the impacts of drought on blue crab populations and the fishery. Five crabbers attended a workshop in October 2015 to learn about a forecasting tool that takes into account environmental, fishery, and economic data that can help crabbers adapt to annual climate-related variability and strengthen the sustainable management of the fishery.

Results: Workshop participants agreed that fishermen involvement in data collection would enhance current fisheries data that could populate this forecasting tool and allow the fishery to more readily adapt to a changing climate. All five fishermen volunteered to become members of the Crabbers Who Care Research Network and collect environmental and fishery data. The Carolinas Integrated Sciences and Assessments program provided refractometers for each member, allowing for real-time salinity measurements. Once a week, fishermen fill out a datasheet that was developed in collaboration with the Consortium's Living Marine Resources Specialist, recording information from five crab pots and associated environmental data. The Consortium plans to expand the Crabbers Who Care Research Network upon successful establishment in the Beaufort County area.

Recap: With support from the SC Sea Grant Consortium, five blue crab fishermen have formed the Crabbers Who Care Research Network, helping to collect data on blue crab populations and environmental conditions. The work of this network will enable crabbers, scientists, and natural resource managers to better understand the impacts of annual climate-related variability and change on blue crabs and strengthen the sustainable management of the fishery.

After Consortium training, South Carolina park rangers implement rip current outreach at their parks

PI: Michael Slattery, SC Sea Grant Consortium

Relevance: Rip currents represent a very real threat to the ocean-going public along the South Carolina coast; multiple fatalities occur annually due to a lack of awareness. Many people visit South Carolina's beachfront parks to take advantage of the state's abundant coastal resources and park amenities. State park superintendents engage in cooperative programming and training programs, and the Consortium joined with the state park system to provide information and training regarding rip currents and the threats associated with them, and sharing the means by which to communicate with park attendees about rip currents. This training allowed for improved interaction with the more than 3 million annual visitors to the coastal state parks.

Response: The South Carolina Sea Grant Consortium (SCSGC) Coastal Processes Extension Specialist, building on prior work with state park rangers, presented rip current outreach/awareness information in a "train the trainer" format to lead rangers from 16 state parks during their annual meeting.

Results: The head rangers brought the material back to their parks and disseminated the information to their interpretive and general ranger staff, particularly those at beachfront parks. This led directly to an additional invitation to work with Huntington Beach State Park to train their summer lifeguards and ranger staff directly.

Recap: As a result of training provided by the SC Sea Grant Consortium, South Carolina State park rangers at 16 parks (including all four coastal parks) are now aware of rip current hazards and how to identify conditions that may lead to rip currents. The rangers are better prepared to communicate these risks to the over 3 million annual park visitors through education activities and signage.

SC Sea Grant invited to speak at public education events on coastal hazards and resources

PI: Michael Slattery, SC Sea Grant Consortium

Relevance: The ability to provide relevant extension material to communities can be encumbered by limiting the pathways of communication. By leveraging partnerships and engaging in community outreach events, SC Sea Grant Consortium can more easily share information on coastal hazards, resiliency and coastal development resources. These pathways are possible through building effective relationships with members of the community. Invitations to take park in the annual Stormfest event (3rd year of participation) through Horry County, the Hurricane Hazel hazard talk (organized by the North Myrtle Beach Historical

Museum) and Earth Day events (hosted by Ripley's Aquarium) allowed the Consortium Coastal Processes Extension Specialist (CPES) to efficiently reach the public regarding a number of important, regional issues.

Response: The Consortium was invited to present information in the form of educational posters regarding beach change/erosion hazards, rip currents (Stormfest) and offshore wind energy development (Earth Day). The Consortium also created a presentation in coordination with the National Weather Service focusing on an extreme flooding event due to the landfall of Hurricane Hazel (1954) and putting that result in perspective with modern day infrastructure in the impacted communities.

Results: More than 3,000 visitors attended Stormfest with at least 500 being directly engaged, approximately 40 persons attended the Hurricane Hazel/storm surge hazard talk, and dozens (mainly children) heard about offshore wind energy at Earth Day via engagement in large scale outreach events.

Recap: The SC Sea Grant Consortium provided beach erosion, storm inundation, and rip hazard information to hundreds of people attending outreach events. Additionally, information regarding the viability and development of offshore wind energy installations was conveyed during Earth Day activities.

The Consortium Assists with Visual Screening of Schools for Potential Seismic Hazards in Charleston County

PI: Samantha Bruce, SC Sea Grant Consortium

Relevance: The coastal plain of South Carolina is classified as a high seismically active region. Approximately 70% of all earthquakes in the state occur in the coastal plain, with the largest concentrations found in three areas: Middleton Place-Summerville, Ravenel- Adams Run-Hollywood, and Bowman. As such, the S.C. Emergency Management Division (SCEMD) partnered with FEMA to assess schools in Charleston County for potential seismic hazards.

Response: The overall objective of the project was first to train qualified individuals in the state to complete rapid visual risk assessments of buildings pre and post earthquakes, and second to have those individuals break into teams to assess 76 schools in Charleston County. In order to best utilize FEMA resources the actual school assessments needed to be completed in five business days (August 4-8, 2014) before the FEMA personnel had to return home. Short on people, SCEMD requested help from area universities and the S.C. Sea Grant Consortium. The Consortium Geospatial Extension Specialist joined the Charleston County seismic hazard risk

assessment team, and trained with FEMA instructors to become certified in FEMA P-154 and ATC-20 to acquire the skills needed to aid in the risk assessments.

Results: The Consortium extension specialist partnered with staff from SCEMD to assess 14 schools within Charleston County. The information collected was incorporated into a SCEMD database and is being shared with the Charleston County School District to help guide the prioritization of school seismic retrofitting in Charleston County.

Recap: The SC Sea Grant Consortium assisted FEMA and the Charleston County School District through conducting risk assessments to earthquake vulnerability at 14 schools in the county.

Consortium Assists South Carolina Community with Identification of Adaptive Responses to Sea Level Rise

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: The 2010 Beaufort County Comprehensive Plan includes a recommendation to consider the impacts of climate change and sea level rise. However, putting this recommendation into action was difficult. The County wanted assistance in a public engagement process to identify local vulnerabilities to sea level rise and develop specific adaptation strategies that will inform the 2015 update of its Comprehensive Plan.

Response: Funded through a NOAA National Sea Grant Office Coastal Community Climate Adaptation Initiative grant, the SC Sea Grant Consortium partnered with the Carolinas Integrated Sciences and Assessments, Social and Environmental Research Institute, and North Carolina Sea Grant to assist the Beaufort County Planning Department with identifying local strategies and actions to directly or indirectly reduce community vulnerability to sea level rise. The project team recruited and facilitated discussion among a group of 19 local decision makers, who identified and prioritized an initial list of adaptation actions. The team then hosted two public workshops, attended by 77 people, to vet and contribute to this action list, narrowing it to 23 adaptation strategies.

Results: The team has drafted a final report, tailored to the needs of County officials, that details local vulnerability to rising seas, the community input process, and the adaptation actions identified through the process. Additional information on what other communities are doing and what tools are available to help are included in the report. This final report has been handed over to the Beaufort County Planning Department for consideration and possible incorporation into their Comprehensive Plan.

Recap: The South Carolina Sea Grant Consortium worked with the Beaufort County Planning Department to develop a series of 23 sea level rise adaptation strategies that are under consideration for incorporation into the 2015 update of the county's Comprehensive Plan.

Consortium Assists South Carolina Coastal Community with Update to its Local Comprehensive Beachfront Management Plan

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: Folly Beach, SC, is a on a barrier island near Charleston, with a modest permanent population of 2,600 and annual tourist visitation of nearly 1,000,000. However, this very popular beach experiences severe chronic erosion. The erosion is due in large part to federally constructed jetties meant to sustain navigable waterways to Charleston Harbor. Due to their special circumstance, Folly Beach is not subject to the same regulations as other beachfront communities, including mandatory revisions to their Local Comprehensive Beach Management Plan (LCBMP), last updated in 1991. Folly Beach directly requested assistance from the SC Sea Grant Consortium in proactively updating their LCBMP.

Response: The Consortium's Climate and Coastal Processes Extension Specialists provided technical support at Folly Beach planning meetings and provided input on the LCBMP. In addition to technical expertise, the Consortium provided beachfront monitoring and erosion data in GIS and .KMZ (Google Earth compatible) formats, as well as additional mapping and survey support via a GIS-specialized intern. The intern completed inventories of all structures along the beachfront and produced GIS products for use in the plan. Folly Beach also consulted with Consortium extension specialists on possible alternatives or enhancements to their strategy of renourishment.

Results: With technical assistance and consultation provided by the SC Sea Grant Consortium, Folly Beach has updated its 24 year old LCBMP. The plan has been submitted to the SC DHEC-Ocean and Coastal Resource Management agency for preliminary review.

Recap: The SC Sea Grant Consortium provided technical assistance to update Folly Beach's Local Comprehensive Beachfront Management Plan, which is in the process of being adopted by SCDHEC-Office of Ocean and Coastal Resource Management.

South Carolina Sea Grant Consortium, in partnership with CISA, leads the Southeast and Caribbean Climate Community of Practice

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: The Southeast and Caribbean Climate Community of Practice (CoP) was organized to bring together individuals from local, state, and federal governments, academia, non-profit organizations, and the private sector in the Southeast US (NC, SC, GA, FL, Puerto Rico) to share and apply climate science and assess how coastal communities and ecosystems can adapt to the impacts of climate variability and change. The CoP held meetings in 2010 and 2012, but has lacked leadership in the past several years.

Response: The SC Sea Grant Consortium's Coastal Climate Extension Specialist became the chairperson of the CoP steering committee in 2014, ensuring the CoP maintains momentum and broadens its reach into communities throughout the region. The CoP steering committee includes leadership from all represented states, federal and local leadership, and non-profit organizations.

Results: The CoP hosted a workgroup meeting at the Carolinas Climate Resilience Conference in Charlotte, NC April 28-29, 2014to re-engage members of the CoP and identify priorities moving forward. CoP leadership hosted a joint webinar with the Gulf of Mexico Climate Community of Practice on the newly released report, *Risky Business: The Economic Risks of Climate Change in the United States*, attended by 60 people. The SCSGC climate extension specialist began providing monthly event emails to the community, and engaged a subcommittee to plan a webinar on how to leverage the Community Rating System for climate adaptation. The CoP has expanded its membership to 159 members, an 18% increase in 2014.

Recap: The South Carolina Sea Grant Consortium has played an instrumental role in revitalizing the Southeast and Caribbean Climate Community of Practice. Membership increased by 18% in 2014, and activities include a monthly email list of upcoming events in the region and webinars of interest to the community.

South Carolina Sea Grant Consortium assists a local sea level rise task force in Beaufort and Port Royal, SC

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: Stakeholders in the city of Beaufort and town of Port Royal have formed a task force to address the area's vulnerability to sea level rise and develop adaptation strategies. There are thirteen members on this task force, including the mayor of Beaufort and planning administrator of Port Royal. The Consortium was asked by the SC Small Business Chamber of Commerce to assist the task force in its efforts.

Response: The Consortium and the Carolinas Integrated Sciences and Assessments program is fostering a local sea level rise task force in Beaufort and Port Royal, SC, by organizing meetings, providing technical assistance to identify areas of concern with the municipalities, and facilitating discussion on adaptation strategies.

Results: The task force has held two organizational meetings and identified eight areas in Beaufort and Port Royal particularly vulnerable to sea level rise. The SC Sea Grant Consortium facilitated meetings with task force members and the public works directors from Beaufort and Port Royal to discuss these and identify potential strategies to mitigate future flood risk. In spring 2015, the task force will present its mission statement and recommendations to Beaufort City Council and Port Royal Town Council.

Recap: The SC Sea Grant Consortium was invited to assist the towns of Beaufort and Port Royal to identify areas vulnerable to sea level rise and develop strategies to mitigate future flood risk via a citizen-driven task force.

South Carolina Sea Grant Consortium Assists Beaufort County in Pre- and Post-Disaster Planning for Episodic and Chronic Water Hazards

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: During the National Sea Grant-funded Beaufort County Sea Level Rise Adaptation project, stakeholders identified the incorporation of long-term sea level rise and storm surge planning into the County's Hazard Mitigation and Disaster Recovery Plans as a specific adaptation strategy the County should consider.

Response: The Consortium's Coastal Climate Extension Specialist was invited to work with Beaufort County's Disaster Recovery Coordinator to begin the process of incorporating sea level rise and future storm surge considerations into the update of the County's Hazard Mitigation and Disaster Recovery Plan updates.

Results: While this work is in its initial phase, the stage has been set to address the implications of sea level rise in Beaufort County's pre- and post-disaster planning. The Consortium, in partnership with the Carolinas Integrated Sciences and Assessments, is compiling successful examples from other communities, and will work with Beaufort County's Disaster Recovery Coordinator to develop a public engagement strategy to create buy-in for this effort.

Recap: The S.C. Sea Grant Consortium is helping Beaufort County, SC to incorporate sea level rise and future storm surge planning into its Hazard Mitigation and Disaster Recovery plans.

South Carolina Sea Grant Consortium Invited to Participate in Planning and Implementation of a DHS Climate Change Adaptation Table Top Exercise in Charleston

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: The Department of Homeland Security's Office of Infrastructure Protection (IP) has recognized the threat of climate change to that nation's critical infrastructure. In an effort to respond to this threat, IP developed a Climate Change Table Top Exercise that was piloted in Charleston, SC. The South Carolina Sea Grant Consortium was invited to actively participate in the planning and implementation of this Table Top Exercise.

Response: The Consortium's Executive Director and Coastal Climate Extension Specialist participated in multiple planning meetings leading up to, and helped facilitate, the Table Top exercise in June 2014. In addition, the Executive Director was invited to provide an introductory presentation which provided foundation for the exercise.

Results: The Climate Change Adaptation Table Top Exercise was attended by 75 participants from the Charleston region to discuss the resilience of the region's critical infrastructure to climate change impacts. A major outcome of this exercise was the development of the Charleston Resilience Network, an emerging local effort of state, county, municipal, and private organizations, including the Consortium, which will work to continue the region's conversation on resilience to episodic and chronic weather and climate hazards and build capability to address these hazards.

Recap: The South Carolina Sea Grant Consortium partnered with the Department of Homeland Security, NOAA, and state agencies within South Carolina to host a local workgroup examining the potential impacts of climate change on critical infrastructure within the Charleston region, leading to the creation of the Charleston Resilience Network.

South Carolina Sea Grant Consortium is Founding Member of Charleston Resilience Network

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: The Department of Homeland Security's Climate Change Table Top Exercise in Charleston, SC, complemented existing hazard analysis and planning efforts within the region, and led to the development of a working group to discuss the creation of a Charleston Resilience Network, a local alliance working to assess specific hazard vulnerabilities and build resilience to flooding and other water-related hazard issues.

Response: The South Carolina Sea Grant Consortium partnered with the City of Charleston, Charleston County Emergency Management, SCDHEC-OCRM, Berkeley-Charleston-Dorchester Council of Governments, and SCANA Corporation as principal organizers of this network. The group will stand up a platform to share information, educate stakeholders, and enhance long-term planning decisions that result in the implementation of effective pre-hazard mitigation strategies and post-hazard recovery efforts.

Results: The Consortium's Executive Director and Coastal Climate Extension Specialist joined with the other principal organizers to hold several organizational meetings to define the mission and scope of the network. The network was officially launched in spring 2015 in conjunction with the National Academy of Sciences Resilient America Roundtable workshop in Charleston.

Recap: In response to a multitude of federal, state, and local resilience initiatives happening within the Charleston region, the South Carolina Sea Grant Consortium has joined with other principal organizers to organize a Charleston Resilience Network. This network will share information, educate stakeholders, and enhance long-term planning decisions that result in the implementation of effective hazard mitigation strategies and recovery efforts in the greater Charleston region.

South Carolina Sea Grant Consortium Invited to Speak on Department of Homeland Security Office Webinar

PI: Elizabeth Fly, SC Sea Grant Consortium

Relevance: The Department of Homeland Security's National Protection and Programs Directorate hosted a national webinar series focused on climate adaptation and extreme water. One specific topic was "Regional Adaptation Strategies for Addressing Sea Level Rise and its Cascading Effects."

Response: The South Carolina Sea Grant Consortium was recognized for its work on sea level rise adaptation planning with local communities, and the Consortium's Coastal Climate Extension Specialist was invited to present a presentation providing specific case studies during the webinar on January 30, 2015. The webinar was attended by 320 people from a variety of federal, state and local agencies.

Results: The Consortium's Coastal Climate Extension Specialist participated in the webinar, which had over 320 active participants. The webinar included 15 minute presentations from four speakers, and a 30-minute question and answer session. From attendees that completed evaluations, 79% of participants felt the information received will effectively inform their decision making regarding risk mitigation and resilience enhancements, and 82% plan to

encourage their agency or organization to incorporate information learned from the webinar into safety, security, or resilience practices.

Recap: The South Carolina Sea Grant Consortium's Coastal Climate Extension Specialist was invited to present South Carolina-specific activities related to sea level rise adaptation for the Department of Homeland Security's webinar, "Regional Adaptation Strategies for Addressing Sea Level Rise and its Cascading Effects." This webinar was attended by over 320 people.