

2019-2020 IMPACTS AND ACCOMPLISHMENTS

HEALTHY COASTAL ECOSYSTEMS



ACCOMPLISHMENTS

Research Highlighted at National Watershed and Stormwater Conference Co-Organized by S.C. Sea Grant Consortium

Hamed Majidzadeh and April Turner, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium and partners organized and led a mobile workshop at the National Watershed and Stormwater Conference in Charleston, S.C. Participants learned about the latest research from the Consortium's Stormwater Ponds Research and Management Collaborative and were given a tour during which municipal stormwater managers highlighted local community examples of best management and maintenance practices.

Relevance: Stormwater ponds (SWPs) are among the most widely used engineering practices controlling stormwater quantity and improving water quality in South Carolina, with more than 9,000 of these ponds located across the state's eight coastal counties. SWP systems can play a significant role in watershed function, providing flood management, pollution mitigation, and other amenities to communities if managed properly. Without regular inspections and proper maintenance, SWPs can be transformed from pollutant sinks to pollutant sources, with implications for downstream ecosystems and human health.

Response: The Consortium, along with partners, organized and led a mobile workshop for the National Watershed and Stormwater Conference in Charleston, S.C. on May 1, 2019. The field tour highlighted the latest research from the Consortium's Stormwater Ponds Research and Management Collaborative and focused on local community examples of pond functionality and best practices for management and maintenance.

Results: Thirty participants, including design engineer consultants, stormwater management professionals, and state and local government agency staff from across the country, joined this 3.5-hour mobile workshop to learn about stormwater pond best management practices implemented in coastal South Carolina communities. This field tour provided participants an opportunity to interact with municipal stormwater professionals from Charleston County, the Town of Mount Pleasant, and the City of Charleston. Topics discussed included: pond design, maintenance, and management; roles and responsibilities for pond owners and local government; managing tidally influenced stormwater ponds; and retrofits, littoral shelves, and other enhancement features. The planning, organization, and administration provided by the Consortium for this workshop are estimated to have provided an economic benefit of \$5,299 based on registration fees paid and opportunity costs of time.

S.C. Sea Grant Consortium Co-Organized Panel Session on Stormwater Pond Management at National Watershed and Stormwater Conference

Hamed Majidzadeh and April Turner, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium, along with its partners, organized and led a panel session at the National

Watershed and Stormwater Conference in Charleston, S.C. Participants learned about Consortium research topics focusing on a geospatial inventory of stormwater ponds, the impacts of ponds on flooding, integration of ponds into the watershed and water quality of receiving waters, the economic benefits of pond management, and tools for outreach about pond maintenance.

Relevance: Stormwater ponds (SWP) are the most common structural best management practice for regulating stormwater runoff in S.C., particularly in coastal areas where development rates are high. SWP systems can play a significant role in watershed function, providing flood management, pollution mitigation, and other amenities to communities if managed properly. Without regular inspections and proper maintenance, SWP can be transformed from pollutant sinks to pollutant sources, with implications for downstream ecosystems and human health.

Response: The Consortium co-organized and led a panel for the National Watershed and Stormwater Conference in Charleston, S.C. on May 1, 2019. The panel, focusing on the function of stormwater management under current and future climate scenarios, highlighted Consortium research including a geospatial inventory of SWP, the impacts of SWP on flooding, integration of SWP into the watershed and water quality of receiving waters, the economic benefits of SWP maintenance and management, and tools for outreach about proper maintenance of SWP.

Results: Thirty-two participants representing federal, state, and local government agencies, universities, design engineering firms, stormwater management professionals, and non-profits attended this panel. As part of the session, participants had the opportunity to engage with scientists, managers, and outreach professionals working on SWP issues and have their questions answered.

S.C. Sea Grant Consortium Organizes Stormwater Workshop: “Shem Creek Water Quality, Past, Present and Future”

Matthew Gorstein and Susan Lovelace, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium (Consortium) fully supported a stormwater workshop, “Shem Creek Water Quality, Past, Present and Future,” to bring stormwater engineering and hydrology consultants together with local government staff and Consortium extension specialists. The planning, organization, and administration provided by the Consortium for this meeting is estimated to have provided an economic benefit of \$3,589.

Relevance: Shem Creek is a multi-use working waterfront in an increasingly urbanized part of the Town of Mount Pleasant. Urbanization and polluted stormwater runoff have led to water quality concerns in the area. The EPA would like the town to set TMDLs. The town is seeking information to determine if there are still measures they can take to improve the water quality in the creek.

Response: The Consortium staff worked with the town to develop and hold a “State of the Knowledge of Shem Creek” Workshop to share and synthesize what we know about Shem Creek, how water quality has changed over time, and to strategize elements and research needs for a watershed management/watershed restoration plan to improve water quality. Several presentations provided overviews of larger or longer projects to understand water quality in the creek.

Results: Participants identified and prioritized short- and long-term strategies for improving the watershed as well as data sets available and research needed. They developed “big ideas” that the town can put into action. The planning, organization, and administration provided by the Consortium for the Shem Creek Water Quality, Past, Present and Future workshop is estimated to have provided an economic benefit of \$3,589 based on travel costs

and opportunity costs of time. Twenty-three (23) non-Consortium participants traveled an average of 10 miles to attend, and these participants were roughly evenly split between stormwater consultants and local government staff. Based on the General Services Administration's (GSA's) privately owned vehicle mileage reimbursement rate of \$0.545 per mile, each participant incurred ($10 \times \$0.545$) \$5.45 in vehicle travel costs. Based on the U.S. Bureau of Labor Statistics (BLS) occupational employment statistics program's mean hourly wages for hydrologists and for urban and regional planners in South Carolina (US BLS, 2019), the mean hourly wage of participants is assumed to be \$27.38. Participants obtained value from this workshop as attending the workshop was deemed an appropriate use of their time by either themselves or their supervisor, they deviated from normal work duties to attend the workshop, and they obtained knowledge and skills. The workshop lasted five and a half hours, therefore each participant has an associated opportunity cost of time of \$150.59 ($\27.38×5.5). Summing with travel costs (\$5.45) yields an economic benefit of \$156.04 per participant. When multiplied by the 23 participants, a total economic benefit of \$3,589 is derived.

Economic Benefit of Stormwater Salinity Study Workshop for Practitioners

April Turner and Matt Gorstein, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium (Consortium) engaged watershed practitioners to gather feedback from the stormwater salinity study advisory committee members to ensure the results are adequately addressing previously identified stormwater management needs. The planning, organization, and administration provided by the Consortium for this meeting is estimated to have provided an economic benefit of \$578.

Relevance: A Consortium-funded research project, *Linking Land Use to Physical Processes in Creeks and Estuaries: Implications for Increased Development and Changes in Climate and Weather*, measures rainfall-runoff-water quality relationships in Charleston-area tidal creeks, develops models to identify relationships to watershed characteristics, and disseminates information to stakeholders. Consortium staff is taking the lead on the engagement process.

Response: The Consortium engaged watershed practitioners on June 4, 2019 to gather feedback from the stormwater salinity study advisory committee members to ensure the results are adequately addressing the stormwater management needs the group had earlier identified and to identify and address any concerns from the managers.

Results: The planning, organization, and administration provided by the Consortium for this meeting is estimated to have provided an economic benefit of \$578 based on travel costs and opportunity costs of time. Ten participants traveled an average of 20 miles to attend. Based on the General Services Administration's (GSA's) privately owned vehicle mileage reimbursement rate of \$0.545 per mile, each participant incurred ($20 \times \$0.545$) \$10.90 in vehicle travel costs. The occupations of the participants were a mix of local government stormwater management staff, non-profit organization representatives, university outreach staff, and engineers. Based on the U.S. Bureau of Labor Statistics (BLS) occupational employment statistics program's mean hourly wages for all occupations in South Carolina (US BLS, 2019), the mean hourly wage of participants is assumed to be \$21.34. Participants obtained value from these meetings as attending was deemed an appropriate use of their time by either themselves or their supervisor, they deviated from normal work duties to attend the workshop, and they obtained knowledge and skills. Approximately 90% of the effort (e.g., funding, resources, logistics, organizing, outreach, etc.) needed for the implementation of these meetings is attributed to the Consortium. The workshop lasted 2.5 hours, therefore each participant is estimated to have an associated opportunity cost of time equal to \$53.35 ($\21.34×2.5). Summing opportunity costs (\$53.35), travel costs (\$10.90), multiplying by the number of participants (10), and multiplying by the attribution factor (90%) yields a total economic benefit of \$578.

S.C. Sea Grant Consortium Contributes to Panel Discussion on Faith Perspectives of Environmental Conservation

Matt Gorstein, S.C. Sea Grant Consortium

Recap: S.C. Sea Grant Consortium staff contributed to a panel focused on faith perspectives in environmental conservation.

Relevance: People of many faiths strive to weave values and programs of care for the environment throughout the entire fabric of their religious life. By the mid-to-late 1980s, portions of the religious community had begun to create responses and programs to address environmental stewardship. In the 1990s, after an open letter sent from 32 Nobel laureates and other eminent scientists, senior religious leaders affirmed the need for theologically grounded, scientifically informed religious initiatives. What followed was a formal consultation with senior religious leaders to lay the groundwork for such action. In October 1993, the National Religious Partnership for the Environment formally began its activities as an alliance of the U.S. Conference of Catholic Bishops, the National Council of Churches, the Coalition on the Environment and Jewish Life, and the Evangelical Environmental Network.

Response: The National Religious Partnership for the Environment, an organization that brings together a diverse alliance of faith institutions and leaders on behalf of caring for the environment, organized a forum at Circular Congregational Church in Charleston, S.C. The focus of the forum was faith perspectives on environmental conservation, and how faith may inspire and call people to be environmentally conscious.

Results: Faith leaders representing different belief systems and diverse communities were invited to speak on these topics. Consortium staff participated and added a scientific, socioeconomic, and Jewish perspective to a panel discussion, focusing on how humans receive a variety of benefits from healthy ecosystems but also must act as stewards of the environment to ensure the future provision of these benefits. Contributing to the panel discussion provided a means for the Consortium to engage with the faith community on a local scale.

S.C. Sea Grant Consortium Co-Organized a Beaufort Stormwater Pond Management Conference

April Turner, S.C. Sea Grant Consortium

Recap: The S.C. Sea Grant Consortium co-organized a pond management conference that provided training and technical assistance to build capacity and inform 85 stormwater professionals, homeowners, and local government officials and staff in Beaufort County. Similar conference planning is underway for the greater Charleston and the Grand Strand regions of the South Carolina coast in 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. Stormwater pond systems can play a significant role in watershed function, providing flood management, pollution mitigation, and other amenities to communities. They also create a unique set of management issues if not properly managed, especially as they age. Without regular inspections and proper maintenance, stormwater ponds can be transformed from pollutant sinks to pollutant sources, with implications for downstream ecosystem and human health. Some of the most common barriers to pond maintenance include lack of awareness of responsibility, misinformation on best management techniques, and financial costs.

Response: The Consortium, along with partners, organized and led a regional pond conference on November 14,

2019, extending the latest stormwater pond scientific information, resources, and tools to public and private sector pond managers and owners in an effort to encourage and promote proper pond maintenance. The goals of this event were to increase awareness about 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 in inspections and management actions.

Results: Eighty-five participants, including property managers, homeowners' association representatives, and pond management professionals, 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 resource information and continuing education credits. Coastal pond research, pond inspection and maintenance, integrated pest management, aquatic weed management, wildlife habitat, sea-level rise impacts, upland management, and capital reserves planning were among the topics addressed. Conference evaluations indicated 94% of participants increased their knowledge of ponds/pond management as a result of the trainings offered, and more than 90% said they learned something new to apply in their future work. Overall, participant feedback revealed attending this event was a good use of their time (95%). The planning, organization, and administration provided by the Consortium for the 2019 Beaufort Stormwater Pond Management Conference is estimated to have provided an economic benefit of \$9,283 based on the provision of continuing education credits (CEUs) at a discounted rate, registration fees, travel costs, and opportunity costs of time.

S.C. Sea Grant Consortium 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 Consortium 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. 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.

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 Marine Resources Research Institute

Recap: S.C. Sea Grant Consortium 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. Additionally, preliminary data has informed predictive tools that have already shown promise. Analysis found statistically significant positive relationships between various metrics of sediment contamination (ERMQ) and development intensity, precipitation amount, and temperature.

S.C. Sea Grant Consortium Examines Coastal Water Quality Response to Increasing Nitrogen Inputs

James Pinckney and Erik Smith, University of South Carolina

Recap: S.C. Sea Grant Consortium research results suggested that ambient nutrient concentrations should not exceed nutrient tipping point concentrations to prevent possible shifts from one ecological state to another.

Relevance: In the Southeast U.S. region, nitrogen is typically the nutrient that controls primary production in estuaries. Excessive nitrogen inputs from anthropogenic sources have been identified as contributing to a general decline in related water quality, including hypoxia, anoxia, fish kills, and harmful algal blooms. Concerns about this decline have led to development of targets for pollution reduction that are meant to ensure a minimum level of acceptable water quality for both ecosystem and public health. Nutrient tipping points may be indicative of the point (i.e., nutrient concentration) at which there is a fundamental change in the way phytoplankton respond to further increases in nutrient loading. The ecological implication is that phytoplankton community processes and

functions may shift from one state to another alternate state at tipping points.

Response: Researchers from the University of South Carolina (USC) Baruch Institute met with staff from the S.C. Department of Health and Environmental Control (SCDHEC) Bureau of Water to discuss the agency's priority research needs and select sites in Winyah Bay and North Inlet for sampling. SCDHEC agreed to provide phytoplankton from their summer surveys to the USC researchers, who quantified nutrient responses of different algal groups (diatoms, cyanobacteria, etc.) and calculated nitrogen uptake rates of the samples.

Results: Preliminary results demonstrate that planktonic diatoms were the algae most responsive to elevated nitrogen inputs, though no obvious significant changes to community composition were observed. The implication is that the tipping point signaled a change in responses that may signal a transition from a relatively stable state to an alternate state with marked changes in community structure and, by extension, function. The consequences for nutrient management are that these tipping points may represent critical values for the determination of water quality nutrient criteria based on fundamental changes in phytoplankton responses to nutrient loading.
