

SOUTH CAROLINA SEA GRANT CONSORTIUM
~ 2015-2016 IMPACTS AND ACCOMPLISHMENTS ~

SUSTAINABLE FISHERIES AND AQUACULTURE

IMPACTS

Aquaculture producers and eco-tour operators in South Carolina diversify income by partnering to offer farm tours

Julie Davis, S.C. Sea Grant Consortium, with Drs. Laurie Jodice and William Norman, Clemson University

Relevance: The aquaculture industry in the southeastern U.S. varies in its prominence within coastal communities. Despite being a major economic driver in some communities, it is not dominant in tourism marketing strategies in the region. As the industry grows so does the interest of residents and visitors alike to learn about the techniques being employed and to find ways to connect to local growers. Growers are eager to share with visitors but need to be able to manage the liabilities, cost, and time commitment associated with doing so, especially when most are small operations.

Response: Clemson University, in partnership with the S.C. Sea Grant Consortium, recently completed a NOAA Sea Grant National Strategic Initiative-funded marine aquaculture study on tourists' perceptions of mariculture in Florida and South Carolina. Part of this study involved conducting interviews with industry members in coastal communities including those in fisheries, aquaculture, tourism, recreation and food service.

Results: Research results as well as suggestions generated during the project were shared with the industry members and resulted in two South Carolina oyster farmers seeking further Consortium guidance on partnering with eco-tour companies to offer farm tours. In 2015, both farms piloted the idea, and, while the increase in revenue is minor to date (<10%), both have plans to increase visitor traffic utilizing the same partnerships in 2016.

Recap: Following S.C. Sea Grant Consortium-supported research, state oyster farmers embraced and implemented eco-tourism as a way to diversify income and gain loyal followers.

Fisheries managers modify blue crab fishery monitoring due to S.C. Sea Grant Consortium-backed climate change research

Dr. Amy Fowler, S.C. Department of Natural Resources; Kelsey McClellan, College of Charleston; Dr. Michael Childress, Clemson University; and Julie Davis, S.C. Sea Grant Consortium

Relevance: In April 2014, during a S.C. Sea Grant Consortium supported Crustacean Research and Management Needs Workshop, a need for research on the impacts of climate change on the blue crab fishery was expressed, including the request for a state of the knowledge document. The group of scientists and fishery managers hypothesized that crab abundance, reproduction, and the range of habitats being utilized may be changing as a result of climate stressors, including drought. For fishermen, drought means crabs follow the salinity wedge higher into the estuary. When drought is severe, crabs are located well above the regulatory freshwater/saltwater



dividing line where fishermen cannot legally fish. Blue crab fishery monitoring includes monitoring trawl surveys and fixed stations that have remained at the same locations since the late 1980s.

Response: In the fall of 2015, the Consortium convened and funded a *Study Group* comprised of S.C. Department of Natural Resources (SCDNR) researchers, extension staff, and a graduate student to compile a draft state of the knowledge report and to quantify the abundance and type of crabs captured relative to salinity. Scientists were interested in introducing methodology that would allow them to follow the crabs relative to salinity, much like fishermen do, to better estimate crab abundance.

Results: The draft document identifies climate-related research needs for blue crab in South Carolina and describes recent market trends. Describing catch relative to the salinity wedge in the Ashley River has led to advancement of the SCDNR blue crab monitoring program, which now will include potting surveys relative to salinity.

Recap: The results of a S.C. Sea Grant Consortium blue crab *Study Group* research project led fishery managers to adjust monitoring programs due to changing conditions and to identify climate-related research needs.

Genetic studies demonstrate the medically valuable South Carolina horseshoe crab population is healthy

Julie Davis, S.C. Sea Grant Consortium, and Dr. Amy Fowler, S.C. Department of Natural Resources

Relevance: In South Carolina horseshoe crabs are harvested solely for biomedical and educational purposes. A component of horseshoe crab blood (*Limulus* amoebocyte lysate, LAL) plays a vital role in detecting contamination of medical equipment and drugs. Charleston is home to one of the world's leaders in the endotoxin detection technology, which bleeds horseshoe crabs to collect LAL. Previous studies demonstrated that 80-90% of crabs survive the bleeding process, but the status of the population as a whole was unknown. In 2013, following a request from the fishing and biomedical industries to determine the status of the South Carolina horseshoe crab population, the S.C. Sea Grant Consortium convened a meeting of S.C. Department of Natural Resources researchers to solicit proposals to best address the industry's question.

Response: The Consortium secured \$62,644 in funding from private industry for a two-year project, which employed a genetic approach to assess the health of the horseshoe crab population. Outreach efforts included development of a "Stranded Horseshoe Crab" brochure targeted at beachfront property owners and attracting mainstream media exposure for the project.

Results: The South Carolina horseshoe crab population is genetically diverse and not geographically segmented along the coast. Contrary to prior studies, researchers determined the population has a large effective population size, an indicator of strong reproductive output and success. Results suggest there is no need for further restrictions on management of this economically and medically important fishery. A peer-reviewed publication is expected in summer 2016.



Recap: A S.C. Sea Grant Consortium-led research effort finds the South Carolina horseshoe crab population is diverse and abundant, ensuring confidence for the expansion of the multi-million dollar industry to meet increasing global demand and providing continued work for horseshoe crab fishermen.

Improving quality and consistency of farmed Southern oysters identified as top research priority
Julie Davis, S.C. Sea Grant Consortium

Relevance: Oyster aquaculture is an emerging industry throughout the U.S. South. Early adopters are experiencing success, but the industry has reached a point where fine-tuning methods to improve quality and consistency of this high-value product is necessary. It is important that organizations, including USDA-SRAC, dedicated to applied aquaculture research, industry partnership, and dissemination of results provide funding to move the industry ahead.

Response: To set research priorities each year USDA-SRAC committee members request short proposals from southern U.S. research institutions for research projects that address industry needs. Proposals are presented by members of the industry and technical committees at SRAC's annual meeting. In 2015, the S.C. Sea Grant Consortium's Living Marine Resources Extension Specialist (LMRES) attended the annual meeting as the South Carolina extension representative proxy on the technical committee, and Frank Roberts of Lady's Island Oyster served as the South Carolina representative on the industry committee. They worked together to present the need within the region for research on improving oyster farming.

Results: After presentation of 20 proposals and two days of negotiating, the need to improve the quality and consistency of farmed Southern oysters emerged as the top research priority for SRAC in 2016. Over 30% of the organization's research funds (\$250,000) were allocated to address this research priority. The Consortium, in partnership with industry and extension partners, was instrumental in communicating the need for this research and its alignment with the SRAC mission.

Recap: The S.C. Sea Grant Consortium, in partnership with regional industry and extension partners, communicated the need for research to help improve quality and consistency of farmed Southern oysters to the USDA-SRAC. As a result, SRAC made the research a priority and assigned over 30% of its budget to address this regional priority in 2016.

S.C. Sea Grant Consortium research helps boost production of valuable single oysters using off-bottom methods
Julie Davis, S.C. Sea Grant Consortium

Relevance: The market for high value single oysters continues to expand throughout the Southeast. Raw bars are offering a variety of premium, farm-raised oysters from throughout the region, and the oysters are being recognized as some of the best available in the nation. The techniques used to grow oysters to meet this demand differ from one region or state to the next. In South Carolina, off-bottom techniques have been tested that proved effective at avoiding excessive bio-fouling and produced an oyster with desirable half shell market attributes. As these methods proved viable, interest by prospective new growers and expansion by existing businesses grew. To meet the demands of increased production, seed production must also increase.



Response: Building on prior Sea Grant research and extension efforts, the S.C. Sea Grant Consortium continues to offer assistance to new oyster producers by responding to requests for information, conducting farm visits, troubleshooting problems, and providing design assistance to optimize new systems.

Results: The Consortium received 22 requests for information about oyster farming and conducted 14 farm visits. Two new oyster farming businesses started in 2015. Seed production remained steady in 2015, producing over 3 million seed valued in excess of \$60,000, but not all seed needs were met due to increased demand. The Consortium has provided technical assistance to hatchery and nursery producers to aid production expansion in 2016. Development of broodstock lines to meet triploid seed needs using all local oysters continues. The Consortium's work is gaining recognition in the community, resulting in a new partnership with the Technical College of the Lowcountry in Beaufort, S.C., to offer training to new and beginning farmers.

Recap: The S.C. Sea Grant Consortium facilitated expansion of the oyster farming industry in South Carolina through in-the-field support and increased industry resilience by assisting the industry as it works towards producing seed using solely local broodstock.

ACCOMPLISHMENTS

S.C. Sea Grant Consortium research probes thermal stress impact on South Carolina oysters to identify safer harvest periods and improve seafood safety

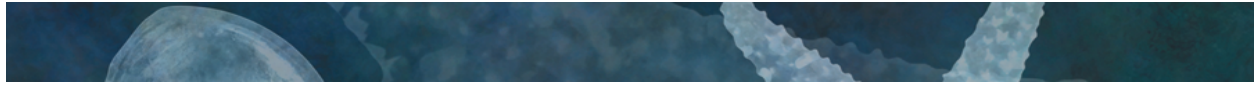
Dr. Charles Lovell, University of South Carolina

Increasing temperatures in coastal regions worldwide are producing more frequent and more widespread outbreaks of the *Vibrio* pathogen. Determining the impacts of thermal stress on oyster *Vibrio* burdens is essential to assuring oyster safety to consumers. S.C. Sea Grant Consortium researchers at the University of South Carolina performed extensive samplings of South Carolina oysters and found densities of *Vibrio* are highly variable between individual oysters, a fact obscured by current U.S. Food and Drug Administration (FDA) protocols. The majority of oysters sampled contained low levels of *Vibrio*, but some contained densities 10-20 times higher than other oysters harvested at the same time, from the same oyster bed. These oysters occur at low frequencies and are referred to as "hot" oysters, due to the presence of infectious levels of vibrios. They showed no overt sign of disease, and there is no way to distinguish a "hot" oyster from a safe oyster until it is homogenized and *Vibrio* cells are recovered and quantified. Current FDA protocols seem to be insufficient to detect the occasional "hot" oyster, thought to be the cause of *V. parahaemolyticus* gastroenteritis. Researchers hope to identify periods of elevated risk and safer periods for oyster harvest to improve seafood safety for consumers.

S.C. Sea Grant Consortium research creates genetic tool to enhance management of commercially-important finfish species

Dr. Dianne Greenfield, University of South Carolina and Dr. Stephen Arnott, S.C. Department of Natural Resources

Indices of fish egg production are essential for understanding recruitment and developing stock assessment models for species management. Traditional methods of enumerating and identifying planktonic fish eggs entail time-consuming microscopy. Furthermore, eggs of different species are often



morphologically indistinguishable, leading to erroneous population assessments that affect management decisions. Consortium researchers addressed this problem by developing and validating a rapid, cost-efficient, and novel molecular tool which facilitates species-specific fish egg identification and quantification, using the economically important species red drum as the target organism. Researchers designed new capture and signal probes for the sequenced genome region, and adapted sandwich hybridization assay (SHA) for red drum eggs. *This is very significant scientifically because it is the first time this assay has been used for quantifying vertebrates.* In addition, the techniques have been validated for cultivated (maricultured) spawned eggs and for field-collected eggs from Charleston harbor. Spyglass Technologies will produce the assays as a commercially available product to enhance fishery management. The company recognizes the relevance of this application to the commercial and recreational fishery sectors.

S.C. Sea Grant Consortium investigates feasibility of creating a South Carolina Seafood Driving Trail
Dr. Robert Brookover, Laura Jodice, Blake Lanford, and Dr. Greg Ramshaw, Clemson University

South Carolina offers a combination of unique experiences related to seafood harvest and production, maritime history and culture, marine fisheries ecology, and seafood culinary interests. A seafood-themed driving trail is a strategy that might stimulate entrepreneurship, create unique opportunities to market sustainable marine resource-based products through a unified brand image, and highlight the authentic culture and heritage of fishing in state tourist destinations. Sea Grant researchers from Clemson University developed a visualization tool to map seafood-related businesses, which could be suitable for inclusion in a South Carolina Seafood Trail. Surveys and a workshop elucidated several challenges facing the development and maintenance of a South Carolina Seafood Trail. Administration and maintenance of the project by a 501(c)(3) cooperative partnership is critical, as are strong relationships with similar efforts in the Southeast and partnerships with regional tourism and seafood industry organizations. A more focused seafood trail might be an appropriate first step as a pilot project to determine whether to expand the effort to encompass the entire coast of South Carolina. Existing infrastructure such as MarketMaker, Certified SC Grown, and other tourism- and culture-based programs should be utilized to promote the effort, while balancing regional differences in seafood products and collaboration to design participation strategies and membership criteria for participation.

S.C. Sea Grant Consortium helps coastal communities identify fishery-related working waterfront priorities for the future

Dr. William Norman, Jennifer Calabria, and Laura Jodice, Clemson University and Julie Davis, S.C. Sea Grant Consortium

South Carolina's fishery-related working waterfronts have faced a variety of challenges in recent years due to declining profits from inconsistent production, increasing pressure from imports, lack of long-term commitment to dock space from waterfront property owners, and increasing high-end residential and commercial waterfront property development. Despite strong cultural and historical seafood ties, South Carolina seafood producers find themselves fighting to maintain, let alone enhance, the waterfront infrastructure vital to their business. The S.C. Sea Grant Consortium convened workshops in five South Carolina coastal communities with significant fishery working waterfronts. Participants used a mapping exercise and questionnaires to identify priorities for a thriving working waterfront and to define a vision for the future. In Georgetown, this led to partnering with the city on development of a grant proposal to address their top priority, abandoned and derelict vessels. The workshops, which were funded through a Consortium *Study Group* grant, are part of a larger initiative to help working waterfront



communities define and plan for their future. Additional activities are to be conducted in the next year.

Sea Grant efforts to assist blue crab fishermen in adapting to a changing climate garner national recognition

Dr. Elizabeth Fly and Julie Davis, S.C. Sea Grant Consortium

In 2013-2014, S.C. Sea Grant Consortium climate and fisheries extension staff completed a NOAA Coastal and Ocean Climate Applications social science project that engaged blue crab fishermen, scientists, and fishery managers in several discussions and exercises in identifying ways to adapt to a changing climate. The Crabbers Who Care Research Network (CWCARN) was born from this effort and is being piloted in Beaufort County, S.C. In 2015, the National Integrated Drought Information System (NIDIS) sought out Consortium extension staff to highlight drought impacts in a video being produced by Sonya Doctorian to promote NIDIS efforts among federal decision-makers. Extension staff coordinated participation of video production staff in a day on the river crabbing, including sampling of catch and salinity by crabbers involved in CWCARN.

Sunray venus clam soil sample kits distributed to determine aquaculture potential in South Carolina waters

Julie Davis, S.C. Sea Grant Consortium

Culturing the sunray venus clam, *Macrocallista nimbosa*, a species native to the area, could be a viable way for South Carolina clam farmers to diversify their production if the right soil conditions exist within their permit areas. The University of Florida (UF) has conducted research on the ideal soil conditions for sunray venus clams and, recognizing that these ideal conditions are sparse within our region, partnered with the S.C. Sea Grant Consortium to make kits available regionally. All existing shellfish mariculture permit holders were made aware of the availability of kits via the S.C. Department of Natural Resources mariculture permit mailing list. Submerged soil kits were provided by UF and distributed to eight shellfish mariculture permit holders in South Carolina. Pending favorable soil test results, plans for the coming year could include demonstrations will be planned at three sites within the state to determine growth rates, survival, growing techniques, and diseases of concern.

S.C. Sea Grant Consortium facilitates industry involvement in South Atlantic Fishery Management Council citizen science workshop

Julie Davis, S.C. Sea Grant Consortium

To meet growing demands for fishery data and make effective use of partnerships with industry, the South Atlantic Fishery Management Council organized a two-day Citizen Science Planning Workshop in January 2016 to determine what the components of a program would need to be and what organizations would be integral partners in the effort. To ease the burden for private sector involvement in the workshop, the Consortium sponsored the involvement of three state fishermen. The workshop was attended by 100 fishery stakeholders from throughout the region who worked to outline goals and objectives of a citizen science initiative. A draft blueprint document (http://safmc.net/sites/default/files/meetings/pdf/Council/2016/03_2016/DataColl/A10_CitSciBlueprintDraft_022916.pdf) outlining the initial vision for a program was developed from the workshop.



S.C. Sea Grant Consortium enhances communication by aiding participation of shrimpers and media in black gill research

Julie Davis, S.C. Sea Grant Consortium

The impact of black gill on the South Atlantic shrimp population continues to be of concern to scientists and fishermen. Black gill causes necrosis of the gill tissue, which can weaken or kill shrimp. Researchers have struggled to identify the parasite that causes black gill. However, research focused on correlating its abundance with environmental conditions has proved useful. As part of a current Georgia Sea Grant-funded project, members of the industry, extension personnel, media representatives, and resource managers joined scientists on a one-day research cruise on the *R/V Savannah* out of Skidaway Institute of Oceanography. By extending an invitation to South Carolina shrimpers and facilitating discussion between fishermen and scientists, the Consortium ensured fishermen's observations would be incorporated into on-going and future research projects. The Consortium also facilitated participation of Southern Tides magazine editor Amy Thurman in the cruise. Thurman produced a thorough article on black gill in the November 2015 issue of Southern Tides

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