

SUSTAINABLE FISHERIES AND AQUACULTURE

IMPACTS

*S.C. Sea Grant Consortium Partnership Supports Aquaculture Business Development by Increasing Oyster Seed Availability*

**Julie Davis, S.C. Sea Grant Consortium**

**Relevance:** In April of 2014, amid concerns over disease transfer, the state of South Carolina introduced a moratorium on importing oyster seed. Prior to that time, three beginning oyster farmers imported seed with no detectable level of disease from hatcheries in Virginia. The moratorium meant that growers had to seek out new seed sources and develop the capacity to produce seed within South Carolina if the industry was to continue to grow. Shortly following the moratorium, a grower expressed an interest in expanding nursery production and building a hatchery to meet their company's needs for diploid and triploid seed as well as the seed needs of all South Carolina growers. The program set out to build an industry that is resilient to environmental and/or regulatory changes in other states by providing a reliable, in-state, commercial source of oyster seed.

**Response:** The S.C. Sea Grant Consortium provided technical expertise on hatchery and nursery system design and standard operating procedures to allow the facility to optimize production. The Consortium also facilitated a partnership to produce triploid oyster seed using South Carolina broodstock. Some of this work was based on Sea Grant Consortium-funded research conducted at the S.C. Department of Natural Resources. During the previous two years (2014 and 2015), the oyster seed development program was going through its development phase; providing seed to commercial growers that originated from Louisiana and Alabama as triploid eyed larvae.

**Results:** In 2016, as a result of Consortium efforts, the seed orders for all South Carolina oyster farmers were filled with seed produced in-state using South Carolina broodstock. Two growers in North Carolina were also able to procure seed from South Carolina. A total of 2.6 million seed were sold, which represents a conservative average market value to the harvester of \$1,092,000. Multiply that several times to determine the restaurant retail value. In 2016, following two years of development work, the Consortium and its partners produced South Carolina tetraploids, which will be used in 2017 to produce South Carolina triploids. These two milestones will provide security for and confidence in the state's oyster industry and will minimize concerns over disease transfer across state lines.

**Recap:** S.C. Sea Grant Consortium research and 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; with a potential value at harvest reaching \$1,000,000 and potential restaurant retail value estimated at \$4,000,000.

*S.C. Sea Grant Consortium Staff Develop an Oyster Farming Inventory Management Tool to Improve Grower Efficiency*

**Julie Davis, S.C. Sea Grant Consortium**

**Relevance:** Oyster farming using off-bottom methods continues to expand in the South Atlantic and Gulf of Mexico regions. Farming using these techniques involves growing oysters in mesh containerized units suspended or floating above the seafloor. Growers routinely service each unit to ensure product quality and carefully track each unit not only for their own information but to meet operational and regulatory

requirements. It is not uncommon for growers to track their inventory in a notebook or other similar paper fashion. As farms scale up, however, using this method can become cumbersome in tracking inventory and planning activities.

**Response:** The Consortium's Living Marine Resources Extension Program and administrative office worked together to develop a simple spreadsheet to track each containerized unit on an oyster farm. The farmer is able to easily determine which bags are due for servicing and what service is due and when. The customizable sheet allows the grower to sort by bag type, seed type or source, location, or service due. The tool was presented to growers at the first OysterSouth Symposium in Auburn, Alabama in January 2017 as well as through one-on-one meetings with growers.

**Results:** Over 10 growers from throughout the South Atlantic and Gulf of Mexico, including six growers in South Carolina, are using the tool to manage their farms. Growers report that it has saved them time and increased their confidence that everything is serviced on-time, which has resulted in improved survival and growth rates of the animals and greater work efficiency.

**Recap:** An oyster farm inventory management tool developed by the S.C. Sea Grant Consortium is improving farming efficiency for over 10 growers throughout the Southeast United States.

### *S.C. Sea Grant Consortium Fuels Emerging Oyster Aquaculture Businesses through Technical Support and Education*

**Julie Davis, S.C. Sea Grant Consortium**

**Relevance:** Demand for high value single oysters continues to grow throughout the nation. The use of off-bottom techniques for growing oysters in South Carolina is gaining popularity. The use of these methods to produce premium single oysters requires growers to become familiar with site conditions, deployment methods, husbandry techniques, business planning, inventory management, and the regulatory climate in which they operate.

**Response:** The Consortium's Living Marine Resources Extension Specialist (LMRES) provides technical assistance to growers in the planning and beginning stages of their business. Support is provided through one-on-one consultations and site visits, collaboration with industry colleagues throughout the region, and communication with local resource managers. The LMRES is able to assist growers with implementing best management practices on their farm and help them to avoid rookie mistakes, thereby placing them on a quicker trajectory toward success.

**Results:** New and beginning oyster farmers in South Carolina are able to make business decisions more confidently because of technical assistance received from the Consortium. In 2016, the Consortium's efforts supported the creation of five new oyster farming businesses and nine new jobs as well as sustaining nine businesses and 20 jobs.

**Recap:** S.C. Sea Grant Consortium continues to be a valuable technical assistance resource for the expanding oyster mariculture industry in South Carolina, contributing to a 78% increase in new businesses in 2016.

## ACCOMPLISHMENTS

### ***S.C. Sea Grant Consortium Fosters Exchange of Information among Beginning Oyster Farmers Throughout the Region by Assisting with First “OysterSouth Symposium”***

**Julie Davis, S.C. Sea Grant Consortium**

The OysterSouth Symposium, funded by the National Sea Grant office, presented the first opportunity for growers, dealers, chefs, researchers, and extension agents from throughout the region to interact and engage in conversation about furthering their oyster farming businesses. The S.C. Sea Grant Consortium’s Living Marine Resources Extension Specialist presented tools and information at the region’s first Oyster South Symposium in Auburn, Alabama in January 2017, including a session on disaster management. The symposium allowed the industry to share ideas on how to overcome common barriers to improved production. Based on assessments before and after, OysterSouth participants from throughout the Southeast and Gulf regions recorded significant increases in knowledge in off-bottom techniques and culture methods used to raise oysters (+25%), assuring oysters are safe for consumption (+12%), and disaster preparation and recovery (+53%). The Symposium will be a biennial event, rotating to a different location throughout the region.

### ***S.C. Sea Grant Consortium Assists East Coast Shellfish Industry with Public Awareness and Outreach Material Design***

**Julie Davis, S.C. Sea Grant Consortium**

The East Coast Shellfish Growers Association (ECSGA) represents over 1,000 shellfish growers located throughout the eastern United States, and the Consortium’s Living Marine Resources Extension Specialist serves as the South Carolina representative on the ECSGA Board of Directors. In an effort to modernize the association’s appeal and better communicate the advantages of expanding shellfish farming, the board sought to create a new brand package, including a logo. Efforts to do so in the past had failed due to lack of consensus among the board. The Consortium facilitated development of a new brand package by chairing a committee for the logo’s development and communicating the association’s needs to graphic designers via creative briefings. Several logos were pitched to the board, and the majority approved a new, modern logo, letterhead, business cards, clothing, and signature block that reflects the diversity of shellfish grown by the east coast shellfish growers as well as the benefits of shellfish farming to ecosystems and society.

### ***Improving Feasibility of a Commercial Lionfish Fishery in the South Atlantic Topic of Discussion at Regional Workshop***

**Julie Davis, S.C. Sea Grant Consortium**

In July 2016, with funding from the National Sea Grant College Program, the Consortium convened a day-long meeting of 16 key stakeholders in commercial-fishery development and invasive-species control to discuss barriers to increasing commercial capture activity for lionfish, *Pterois volitans*, in South Carolina. Participants included the Reef Environmental Education Fund, S.C. Department of Natural Resources, Florida Fish and Wildlife Conservation Commission, Georgia Sea Grant, South Atlantic Fishery Management Council, dive operators, chefs, and commercial fishermen. Methods used for controlling lionfish populations in shallow, clear water in the Caribbean and Florida (i.e. SCUBA and pole spear) are inefficient in the murky, and much deeper, waters of South Carolina. In preparation for the meeting, a graduate intern conducted research on the lionfish supply chain and summarized recent regional research results. The group was successful in identifying major policy barriers to increased commercial

activity for lionfish, which are summarized in a draft workshop report. The group also identified several technology-related research needs to improve capture efficiency in order to meet management requirements and make commercial activity economically viable in the deep waters where lionfish are found in South Carolina.

### ***18<sup>th</sup> International Conference on Shellfish Restoration Draws Large Crowd and Supports Increased Participation by Community Groups***

**Julie Davis, S.C. Sea Grant Consortium**

Anxious to turn the tide on declining environmental quality, a group of government, industry, and community representatives came together in 1995 to plan the first International Conference on Shellfish Restoration (ICSR) held on Hilton Head Island, South Carolina in 1996. Since then, there have been 17 events, and the conference has been hosted in Canada, Ireland, Scotland, France, and the Netherlands as well as the United States. ICSR provides opportunities for resource managers, shellfish farmers, community activists, historians, and anthropologists to exchange ideas and information to enhance their ability to restore molluscan shellfish populations, improve water quality, and protect environmental health. The S.C. Sea Grant Consortium and its partner organizations planned, organized, and convened the 18<sup>th</sup> Annual International Conference on Shellfish Restoration, held in Charleston, SC on November 16-19, 2016. The highlighted theme for ICSR'16 was "Celebrating and Inspiring Healthy Coastal Communities" with three conference themes: restoration of shellfish ecosystems, rehabilitation and enhancement of shellfish populations, and protection and improvement of water quality for shellfish survival, growth, and harvest. The conference program featured three full days of plenary sessions. Keynote speakers with backgrounds in private business, academia, and local government were featured. Over 125 people attended, including representatives from the United Kingdom, the United States, the Netherlands, Micronesia, New Zealand, and Italy. Participants represented industry, academia, local, federal and state government, communities, and non-governmental organizations. Support from the National Sea Grant College Program supported the attendance of six community groups from around the country and one international group. A total of \$14,000 in sponsorships was raised to support the conference.

### ***S.C. Sea Grant Consortium Facilitates South Atlantic Shellfish Initiative Session to Maximize Benefits of Shellfish***

**Julie Davis, S.C. Sea Grant Consortium**

In November 2016, with funding from the National Sea Grant College Program, a group of 30 shellfish stakeholders – including restoration practitioners, shellfish growers, scientists, educators, resource managers, and municipal staff from throughout the South Atlantic –gathered in Charleston, South Carolina, to discuss their vision for a South Atlantic Shellfish Initiative. The S.C. Sea Grant Consortium, in cooperation with Sea Grant programs from throughout the region, hosted and facilitated the day-long discussion. Stakeholders created a vision over the next 2-20 years on the status of shellfish populations and their associated benefits. They also documented priority issues that need to be addressed in research, management, financing, permitting, communication, and outreach in order to achieve their vision. A draft "South Atlantic Shellfish Initiative Vision" document is in preparation and will be built upon in further discussions with additional stakeholders.

### ***Festival-goers Gain Insight into Soft Shell Crab Production with Demonstration by Consortium, Industry, and Community Partners***

**Julie Davis, S.C. Sea Grant Consortium**

In an effort to educate the general public about fishery production techniques, the S.C. Sea Grant Consortium's Living Marine Resources Extension Specialist partnered with Sea Eagle Market and the Port Royal Sound Foundation Maritime Center to offer a hands-on, live demonstration of soft shell crab shedding at the annual Port Royal Soft Shell Crab Festival. Attendees were educated about capture techniques, fishery traditions, the crab's life cycle and seasonal availability of soft shell crabs. Over 300 attendees witnessed blue crabs molting their shells to become soft shell crabs and gained an appreciation for the effort required to produce this value-added fishery product.

### ***S.C. Sea Grant Consortium Scientists Developing Restoration Strategies for Inshore Cobia Populations*** **Tanya Darden, Mike Denson, and Christopher Katalinas, S.C. Department of Natural Resources**

Cobia is the target of a well-developed recreational fishery in South Carolina. In S.C. waters, the population of cobia has a genetically distinct inshore spawning aggregation, separate from offshore populations. Recent estimates of inshore abundance indicate the population is declining. Concerns over the status of the inshore cobia population in S.C. have been raised by stakeholders, including state resource managers, recreational fishermen, and charter-boat captains, and conservation actions may become necessary. S.C. Sea Grant Consortium researchers at the S.C. Department of Natural Resources-Marine Resources Research Institute are examining a combination of stock enhancement and harvest reductions to facilitate recovery of the inshore cobia population. Using computer simulations, researchers were able to forecast population abundance and genetic diversity of inshore cobia populations under several stock-enhancement strategies and fishery-management options. The resulting model provides resource managers with an objective, transparent, and defensible decision-making tool to choose the best combination of management choices for the inshore cobia population. The optimal restoration strategy includes a combination of more restrictive fishing regulations and stock enhancement, as together these management actions have a greater potential for rapid success than either does alone. The research, outreach, and education components of the project have the potential to lead to a better understanding of the importance of considering effective population size in conservation restoration programs.

### ***S.C. Sea Grant Consortium Helps Establish Lab to Examine Oyster Adaptation and Shell Formation under Ocean Acidification***

**Andrew Mount, Clemson University**

A significant challenge to conducting marine invertebrate research on the main campus at Clemson University is that it is located over 230 miles from the coast. This problem had been previously surmounted by obtaining adult oysters from the Gulf of Mexico and maintaining the animals in a 180-gallon tank of filtered and recirculating artificial seawater. The oysters were fed an artificial shellfish diet. Under these conditions experimental animals could be held successfully for up to 4-6 weeks. After about six weeks of holding, the animals' innate immune response deactivates, and the nitrite concentrations in the tank rise to near toxic levels. Recently there has been a decline in the tap water quality supplied to the lab, which led to an additional uncertainty concerning the quality of artificial seawater. The lack of high water quality, lack of live algae for feeding, and lack of nitrogenous waste removal made for an oyster holding facility incapable of supporting larval-rearing and ocean-acidification experiments. With the support of the S.C. Sea Grant Consortium, the laboratory is now fully

capable of maintaining, growing, and rearing food-quality oysters and their larvae. Researchers are also able to perform and monitor ocean acidification experiments in the best possible manner. The close proximity of these animals to our laboratory and to its complement of fluorescent, confocal, and multi-photon microscopes holds great promise for the advancement of a better understanding of oyster adaptation and shell formation.

### ***S.C. Sea Grant Consortium Research Probes Thermal Stress Impact on Oysters to Identify Safer Harvest Periods***

**Charles R. 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 *Vibrio* gastroenteritis. Researchers hoped to identify periods of elevated risk and safer periods for oyster harvest to improve seafood safety for consumers. High variability in levels of *Vibrio* among oysters harvested from the same bed at the same time confounded the researchers’ ability to define periods of elevated risk. Researchers hypothesized that particular genes may play a role in persistence of vibrios within oyster tissues, and they suggest further studies to determine whether the genes in fact influence *Vibrio* persistence.