NUMBER 55
SUMMER 2021

Coastal Clips

A quarterly publication of the Louisiana Sea Grant College Program at Louisiana State University, Baton Rouge

Grants Available for Alternative Oyster Culture

Louisiana Sea Grant (LSG) has received a $3 million grant from the Louisiana Department of Wildlife and Fisheries (LDWF) and the Coastal Protection and Restoration Authority (CPRA) to expand Alternative Oyster Culture (AOC) throughout the coast.

AOC is when oysters are grown in floating cages or in bottom-placed cages attached to pylons. This method allows the cages to be raised and lowered to protect oysters from predators, fouling and the burial effects of disasters like hurricanes. LSG has operated an AOC demonstration farm on Grand Isle for more than a decade and began researching Alternative Oyster Culture in the late 1980s.

The goal of the project is to begin expanding AOC operations across the state within three years. That includes establishing AOC seed nurseries and grow-out facilities, hatcheries and areas legally designated as AOC Management Units (parks) that contain multiple farms in one location.

"Our objective is to supply AOC operators with the necessary resources like education, business tools, equipment and public outreach to increase their chances of success," said Thomas Hymel, LSG and LSU AgCenter Extension agent who is serving as the project lead. "Alternative oyster culture was identified as an important adaptation strategy by people in the oyster industry during Louisiana's Seafood Future workshops and surveys. This grant is in direct response to industry suggestion; offering direct economic development assistance."

One aspect of the project is $1.8 million in grants that AOC operators can apply for to purchase equipment and supplies to enhance existing businesses or establish new AOC businesses. Grant categories include oyster parks, seed nurseries, grow-out farms and hatcheries. Applicants would be required to meet a number of eligibility requirements, such as possessing a Louisiana oyster harvester license and commercial fishing license, be a resident of the state and not have been convicted of a Class 4 or greater oyster-related violation. Grants also are contingent on the availability of funds.

Grant recipients will have to develop their businesses according to an established timeline, periodically report on how the grant contract is being fulfilled in a timely fashion and demonstrate that a marketable oyster product is being grown and cultivated. An extension of the timeline could be approved for things such as bad weather and equipment purchase backlogs.

"AOC isn't a replacement for the traditional oyster fishery," said Earl Melancon, who leads the team with Hymel on the project and who is a LSG Scholar and formerly a Nicholls State University professor emeritus with 45 years of working with the oyster industry, "It's a supplement for those fishers who have an interest in developing a new method of bringing a valuable Louisiana product to market."

Added Hymel, "For an alternative oyster culture operation to be a successful business, it's necessary that their marketing strategies portray the product as a boutique-style of oyster – which it is – and that the branding and marketing doesn't negatively impact our traditional oyster fishery."

Hymel and Melancon acknowledge that such a large and complex project requires a professional team with diverse expertise. Key personnel contributing to the project include Brian Callam (LSG oyster specialist and oyster hatchery director), Rusty Gaudé (LSG/LSU AgCenter marine extension agent), Jim Wilkins (LSG Law & Policy Program director), Julie Lively (LSG executive director) and Evelyn Watts (LSG/LSU AgCenter seafood extension specialist).

"This program comes at a critical moment for the industry," said Callam. "Current AOC farmers have been hit extremely hard in recent years by both the multitude of storms battering the coast, causing many farmers to lose most of their oysters and equipment, and the pandemic that has made selling oysters almost an impossibility. There has also been increasing interest from the oyster industry to diversify the production of the oysters they cultivate, so having a program that offers grant support and the diverse expertise to assist in its implementation should go a long way."

Details about the project and grants can be found at *www.laseafoodfuture.com/aoc*.

Lively Named Louisiana Sea Grant Executive Director

Julie Anderson Lively has been named the new Executive Director of the Louisiana Sea Grant College Program (LSG). She began her appointment July 1.

"Since her arrival at LSU in 2010, Lively has led a wide range of Sea-Grant-related research projects supported by more than $23 million in funding for which she has been either principal or co-principal investigator," said Sam Bentley, Louisiana State University (LSU) Vice President for the Office of Research and Economic Development. "She leads a diverse research team of extension associates, graduate and undergraduate students and post-doctoral researchers in a portfolio of work that blends research and extension, both core missions of Sea Grant. The search committee was deeply impressed by her central role in numerous regional and national Sea Grant panels and networks."

Julie Lively

Lively, an associate professor in LSU's School of Renewable Natural Resources and LSG's and the LSU AgCenter's fisheries specialist, began her career at LSU in 2010. She earned her Ph.D. in marine biology from the University of Delaware.

"I'm very excited to lead such a great organization and group of people," said Lively. "Louisiana Sea Grant is not only about high-quality research; it is uniquely positioned at the integration of applied research, extension and education to solve problems for the people and communities of coastal Louisiana and beyond."

Lively is Louisiana Sea Grant's fourth Executive Director since the program's establishment in 1968. She replaces Robert Twilley, professor in the LSU College of the Coast and Environment, who announced his departure from Sea Grant in December to concentrate on his existing research.

Louisiana Sea Grant Expands to Meet New Interdisciplinary Coastal Challenges

The Louisiana Sea Grant College Program has grown. In March, the new Department of Education and Engagement was added to build more integrated impacts in effective environmental literacy, outreach and education programs. The goal is for this new department to find greater synergies between existing departments and find new and impactful ways for Louisiana Sea Grant to continue to support its stakeholders

The Education and Engagement unit will not be just a cross-cutting department, but a cross-connecting one. The challenges facing Louisiana are complex—a highly engineered landscape, rapid rates of coastal wetland loss, vulnerability to storms and flooding, fishing industries dealing with chronic and emerging threats—and require a concerted approach. This department will provide strong educational support and stakeholder engagement by addressing issues facing our coast and research attempts to address these challenges.

The program will be managed by Dani DiIullo, who is no stranger to Louisiana Sea Grant. For the last five years, DiIullo has served as communications coordinator with the organization, overseeing and growing both the LaDIA (Louisiana Discovery, Integration and Application) research engagement program


Dani DiIullo

and the Watch the Delta Grow youth education modules. She has taught both in the classroom and in outdoor education; has worked with universities, state agencies, non-profits and museums.

In her new role, DiIullo will oversee a staff of four to deliver many historically popular programs, while looking to expand into new opportunities. The new Department of Education and Engagement will continue promoting the long-term impactful programs such as Ocean Commotion, Coastal Roots, LaDIA, Watch the Delta Grow, EnvironMentors and field-based teacher professional development workshops. DiIullo will push to include new initiatives, including community science as a tool to enforce place-based engagement; providing new, innovative ways to support teachers given COVID-19 classroom challenges and expanding workforce development opportunities.

"Louisiana has the best coastal classroom," said DiIullo. "We are surrounded by incredible tools to teach about wetlands, fisheries, water quality, geology, climate and engineering. I look forward to building these experiences into new environmental literacy and workforce development opportunities."

2021 UROP Projects Announced

This year the Louisiana Sea Grant (LSG) College Program is funding eight Undergraduate Research Opportunities Program (UROP) projects. Established in 1992 to provide talented undergraduate students with hands-on research experience, it has funded more than 200 projects.

Each UROP student will gain first-hand knowledge regarding the whole research process from design, implementation, analysis and conclusion. The hope is for students to present at relevant conferences and publish in peer-reviewed scientific journals.

To support these advanced coastal studies, projects receive funding up to $3,000. UROP applications are accepted each fall for projects starting the following March. Full-time undergraduate students at all Louisiana colleges and universities are eligible.

Mason Bailey, Louisiana State University (LSU)
Advisor: Maria Teresa Gutierrez-Wing
Cryopreservation to Secure Hatcheries Macroalgal Feeds

In hatcheries, larval finfish and shellfish require high-quality microalgae for food before they move on to larger formula feeds or zooplankton. Microalgae can represent a large part of a hatchery budget and maintaining live algal cultures during the off-season or periods of cleaning is costly. On this project, Bailey will investigate the conditions that lead to successful recovery of microalgal strains after cryopreservation. The results could allow hatcheries to freeze and successfully restart their own microalgae cultures, saving the industry money.

Olivia Barfield, Tulane University (TU)
Advisor: Sunshine Van Bael
Inoculation of Baldcypress with Salt-tolerant Endophytes

Baldcypress is a key species for coastal restoration. Endophytes – microscopic fungi and bacteria that live entirely within the tissues of their host plants – can substantially improve a host's ability to withstand stressors, such as increased salinity and temperature variation. Barfield seeks to better understand the longevity of 46 salt-tolerant bacteria and fungi in the baldcypress roots and learn how the symbionts influence seeding growth. Results could be used to increase the success and resilience of bald cypress planting projects in coastal restoration.

Mary Barrow, TU
Advisor: Emily Farrer
Resilience of Coastal Marsh Microbial Communities to Saltwater Intrusion

Louisiana's coastal marshes provide essential services, such as buffering storm surge and providing nursery habitat for commercial and recreational fisheries, as well as having a cultural importance. Understanding whether soil microbial communities – critical for marsh health – are resistant and resilient to saltwater pulses is important in understanding how microbially driven functions in coastal marshes could shift with increasing saltwater intrusion. On this project, Barrow will determine how coastal marsh soil microbial communities respond to salinity pulses from factors such as sea level rise and storm surge.

Natalia Matossian, TU
Advisor: Torbjorn Tornqvist
Quantifying Carbon Burial Rates as a Critical Ecosystem Service in the Mississippi Delta

Coastal and deltaic environments have the potential to offer a major ecosystem service in carbon burial, commonly referred to as blue carbon. This storage has potentially significant implications for the global carbon cycle. Matossian will determine whether significant differences exist in the organic carbon burial rates between terrestrial (delta plain) and marine environments. The research could advise which Louisiana ecosystems are most likely to bury organic carbon most rapidly.

Mary Conde, LSU **Caleb Gryder, LSU** **Ben Walker, LSU**
Advisor: Terrence Tiersch
Custom Design, Fabrication and Testing of Environmental Data Systems for Use in Oyster Aquaculture

Oyster aquaculture plays a growing role in Louisiana's seafood production. One area of concern is wave action, which can directly influence the feeding, growth and health of oysters held in systems such as long-line culture baskets. In this project, Conde, Gryder and Walker will develop a technology-based solution to standardize measurements of environmental factors and how these factors affect off-bottom cultured oysters. Such information could be used to adjust growth conditions to maximize production in the oyster aquaculture industry.

Jacob Hagen, Nicholls State University
Advisor: Enmin Zou
Does Bursicon Control Exoskeletal Mineralization in the Post-Ecdysial Blue Crab, Callinectes sapidus*?*

Crustaceans shed their exoskeleton numerous times during their lives through the process of ecdysis, commonly known as molting. Ecdysis allows the crustacean to grow and develop, but which hormone regulates exoskeletal hardening remains unknown. Hagen will examine the role of bursicon in post-ecdysial calcification of the blue crab, *Callinectes sapidus*, exoskeleton. Findings from this project could be applied to the soft-shell crab industry, where slowing the shell-hardening process is desirable. This research also would advance the scientific understanding of post-ecdysial exoskeleton mineralization.

Vivian Mire, University of Louisiana at Lafayette
Advisor: Beth Stauffer
Effects of Estuarine Freshening on Predator-Prey Interactions in Plankton Food Webs

Louisiana's coastal waters are home to several economically and ecologically important fisheries, including oysters, shrimp, menhaden and blue crabs. Each fishery is directly or indirectly dependent on plankton at the base of the food web. Increasing seasonal river floods and intense, wet hurricanes result in the freshening of coastal waters, impacting microbial plankton production and community structure, and disrupting the food web. Mire hopes to provide a better understanding of how less salty estuaries impact planktonic food webs.

Genesis Mize, LSU
Advisor: Megan La Peyre
Hypoxia Tolerance of Diploid and Triploid Native Louisiana Populations

Improving the selection criteria for broodstock of diploid and triploid oysters is important for coastal restoration and aquaculture. To accomplish this, Mize will compare the survival and physiological response of two oyster stocks derived from three different Louisiana estuaries, and compare their diploid and triploid offspring in laboratory-controlled hypoxia experiments. Hypoxia-resilient diploid oysters, which have two sets of chromosomes, could aid restoration efforts. Hypoxia-resilient triploid oysters, which have three sets of chromosomes, could be useful in oyster farming.

Four CSAP Projects Announced

The Louisiana Coastal Protection and Restoration Authority (CPRA) is continuing its commitment to the Coastal Science Assistantship Program (CSAP). This program provides support for master's students involved in research relevant to Louisiana coastal protection efforts. This collaboration offers the dual benefit of engaging students in CPRA activities while providing for potential recruitment of qualified personnel.

Louisiana Sea Grant administers these assistantships – available to all Louisiana university faculty – to recruit outstanding students to coastal restoration-related research. Up to four new projects are funded annually with an award of $25,000 each for up to three years. The newest projects, students and principal investigators (PI) are:

The Effect of 'Freshening' by Sediment Diversion Flow on the Porewater Salinity, Nutrient Availability and Water Quality Improvement Functions of Barataria Bay Marsh Soil

Student: **Robert Feder**, Louisiana State University (LSU)
PI: John R. White, LSU

Coastal restoration efforts in Louisiana rely on river re-connection with the coastal basins to deliver sediment to these subsiding (sinking) systems. Previous models show surface water salinity will be lower after the Mid-Barataria Sediment Diversion. The question remains, how will this change affect the wetland plants and the microbial pool (all of which control important processes within coastal wetlands) present within the basin's soil? Feder will be investigating how river reconnection and ultimately freshwater reconnection alters porewater salinity and other biogeochemical processes in a range of coastal systems (i.e., freshwater marsh, brackish marsh and salt marsh). He hopes to expand his quantitative skillset and understanding of coastal processes so that he can pursue a career in designing and implementing wetland restoration projects. Ultimately, Feder hopes to collaborate with scientists, engineers and policymakers on safeguarding the ecosystem services that our wetland systems provide.

Can Ribbed Mussels Augment Coastal Restoration Projects in a World of Rising Seas?

Student: **Skylar Line**r, LSU
PI: Brian Roberts, Louisiana Universities Marine Consortium (LUMCON)

Sea level rise (SLR) has been an increasing threat to critical coastal wetlands across the world. Louisiana's coastal wetlands are experiencing the highest SLR impacts, requiring intervention efforts in the form of coastal restoration projects. Examples of coastal restoration projects most prominently used are sediment diversions and living shorelines. Liner's research will focus on understanding the potential of the ribbed mussel (Geukensia spp.) for augmenting living shoreline creation and productivity with the increasing impacts of SLR. The research takes place in two parts: part one utilizing a marsh organ to evaluate the ribbed mussels' resilience to differing inundation periods projected with SLR; part two will observe the plant responses to low and high densities ribbed mussels. Liner hopes to contribute to the preservation of Louisiana's coastal ecosystems and the communities within them. Her family's strong ties to coastal Louisiana's bayous and fishing communities inspire her efforts. Ultimately, she plans to use her master's degree to create a career in the government sector by participating in large-scale restoration projects and outreach efforts across the Louisiana coast.

Comprehensive Sediment Balance of Marsh Creation Projects: From Hydraulic Dredging to Self-weight Consolidation

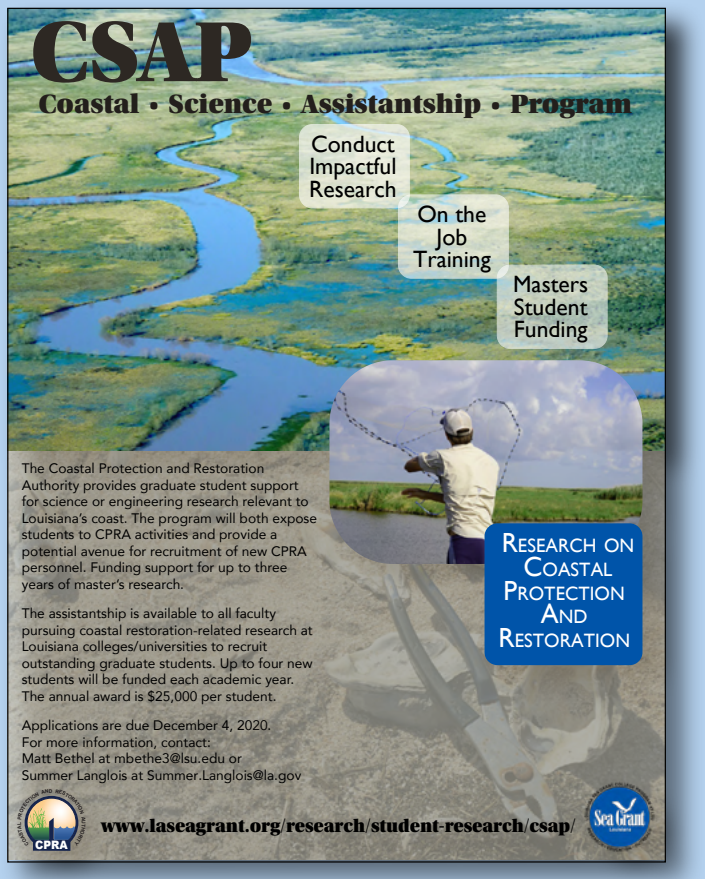
Student: **Omar Alawnen**, LSU
PI: Navid Jafari, LSU

Sediment diversions are a way to help address Louisiana's rapid coastal land loss. Diversions uniquely restore natural water flow, encourage land building sediment and cultivate marshes. This project focuses on investigating the effectiveness of diversions in both the Barataria and Breton Sound basins using the Fort St. Phillip crevasse as a natural surrogate. This project aims to develop and validate models predicting accuracy in sediment compressibility and erodibility and measure the amount of newly formed wetland. This project data will contribute to a growing database regarding erosional and consolidation processes before newly formed wetlands occur.

Quantifying Sediment Retention and Morphologic Evolution in the Fort St. Phillip Crevasse Complex: Implications to Sediment Diversions

Student: To Be Determined
PI: Ehab Meselhe, Tulane University

Sediment diversions represent one of the strategies to help address Louisiana's rapid coastal land loss. Diversions uniquely restore natural water flow, encourage land building and provide nourishment to existing marshes. This project will use dual observation-modeling approach to improve the understanding of the role stratigraphy plays in the formation and resilience of new and existing wetland areas. This project, collaboratively with Navid Jafari's project titled "Comprehensive Sediment Balance of Marsh Creation Projects: From Hydraulic Dredging to Self-weight Consolidation," will focus on the development of numerical models supported and validated by field observations and laboratory testing. The primary goal of this project is to reduce uncertainty and optimize the operation strategies of proposed sediment diversions.



Four Knauss Finalists from Louisiana

Three graduate students at Louisiana State University (LSU) and one from Loyola University have been named 2022 Knauss Fellowship finalists. At LSU in the Department of Oceanography and Coastal Sciences, Nazla Bushra is a doctoral student who will graduate in August; Elsa Gutierrez is a master's student who will graduate in May 2022; and Allyson Kristan is a master's student who will graduate in August. Spring Gaines graduated in December 2020 from the Loyola University New Orleans College of Law.


Nazla Bushra

Bushra is a native of Bangladesh who earned her undergraduate and master's degrees in geography and the environment from the University of Dhaka in Bangladesh, as well a master's degree from LSU. "In my native Bangladesh, preparing for and combating the consequences of deadly hurricanes, storm surge and flooding is a part of life," she said. "The suffering, disproportionately borne by impoverished people, motivated me to become an atmospheric science researcher to improve the lives in the coastal community. But research, including that on natural hazards, without action goes wasted." Bushra's research examines atmospheric circulation features that may influence coastal hazards with the hope of providing better hazards predictions. "All of my research is dedicated to supporting climate adaptation and mitigation, promoting a society better able to respond to weather challenges and enhancing resilience in coastal communities and economies," she said.


Spring Gaines

Gaines grew up in St. Bernard Parish and earned her undergraduate degree in marine biology from Nicholls State University and her juris doctorate and master of laws in environmental law from Loyola. "Growing up, being a good steward of our wetlands was important to me, which made the devastation of important marine habitats after Hurricane Katrina all the more painful," she said. "Since then, I have worked as a wetland educator, marine education specialist and special programs coordinator at a marine mammal rehabilitation non-profit. Now, as a lawyer, I utilize my joint background in marine science and education to be a bridge between complex coastal science and policy and law." Gaines added. "With the abilities and experiences I will earn through the Knauss Fellowship, I can be the Louisiana lawyer on Capitol Hill discussing how my home is a sentinel state for the issues affecting our coastlines nation-wide. My career goal is to influence federal policy to foster stewardship for our oceans and the many creatures and plant life that make their homes there."


Elsa Gutierrez

Gutierrez earned her undergraduate degree in biology from Texas A&M University at Galveston. "All my life, I've been translating – whether it was translating from English to Spanish, or vice versa, to convey thoughts and ideas in my community or translating scientific findings into terminology accessible to a broader audience," she said. "Growing up in a border town, I was surrounded by two cultures and languages; this upbringing shaped my desire to be a bridge connecting science to communities from Mexico and the United States." Her research at LSU involves establishing an age and growth curve for blackfin tuna in the Gulf of Mexico, as there are few studies on this species. The overall objective of the research is to know more about the life history of blackfin tuna in the Gulf in order to protect the fishery and avoid a population collapse. "As a Fellow, I intend to connect with management and policy leaders with similar and opposing views, to broaden my perspective and become a better leader for my community. As a bilingual, bicultural, goal-oriented individual with a passion for marine life, I will strive for long-term goals that seek to use science to connect and improve the lives of our many diverse coastal communities," Gutierrez added.


Allyson Kristan

Kristan earned her bachelor of science degree in marine biology from the University of North Carolina-Wilmington. "Not all beings have the ability to clearly articulate their message, but I've been fortunate to see how research, service and education can give voice to the voiceless and galvanize lasting change," said Kristan. "Whether researching penguins in their imperiled Antarctic environment, rehabilitating sea turtles for their oceanic return or encouraging tourists to incorporate simple steps that foster ocean stewardship, I use my dedication to threatened species and environments to carry these conservation messages forward and amplify unheard voices, creating change that endures." Kristan's research while at LSU included analyzing heavy metals in penguin eggshells to determine whether natural or anthropogenic phenomena are driving intraspecific variation around the Antarctic Peninsula. "I have been shaped by work in extreme environments and influenced by the importance of speaking up and enacting change where needed," she added. "I keep one foot firmly rooted in science, and one stepping into the unknown, overlooked or understudied. I will champion science, working to ensure that it effectively informs the decision-making process."

Sponsored by the National Sea Grant College Program, the John A. Knauss Fellowship matches graduate students with an interest in ocean and coastal resources and national policy affecting those resources with hosts in federal legislative or executive branch offices for one year. In November, finalists from across the country will travel to Washington, D.C., to determine in which offices they will work. Fellowships will begin Feb. 1, 2022.

LSG Helps Develop Oyster Broodstock, Robotic Oyster Farming

Louisiana Sea Grant is part of a $5 million, five-year Gulf-wide effort to develop a genetically superior oyster broodstock for aquaculture. LSG's share of the research funding is $200,000.

The Gulf States Marine Fisheries Commission Oyster Consortia's primary objectives are to develop improved lines of eastern oysters for the oyster industry and develop platforms to distribute improved oyster seed to where it is needed. "The first phase of the project was collecting wild oysters that have superior traits," said Brian Callam, director of the LSG oyster research lab on Grand Isle.

"The next phase is field testing," Callam said. "The goal is to create a broodstock – or trade set – of oysters that can be made available to Alternative Oyster Culture (AOC) hatcheries and are ideal for those grow-out locations."

AOC – sometimes called off-bottom culture – is when oysters are grown in floating cages or in cages attached to pylons. This method allows the cages to be raised and lowered to protect oysters from predators, fouling and the effects of disasters like hurricanes. LSG has operated an AOC demonstration farm on Grand Isle for more than a decade and began researching alternative oyster culture in the late 1980s.

The project could result in oysters identified as having superior traits, collected from across Louisiana, being used to propagate oyster seed that would be used for alternative oyster culture along the state's southwest coast, for example. Louisiana oyster seed could also end up in other states, if they perform well at those other locations. "But generally speaking, Louisiana oysters don't do well in Florida waters, and Florida oysters don't do well in Louisiana waters," Callam said.

The project comes out of a National Oceanic and Atmospheric Administration (NOAA) effort to coordinate oyster genetics research along the Gulf of Mexico. All five Gulf states are participating in the project.

Callam also is involved in a $10 million, five-year U.S. Department of Agriculture (USDA) grant, led by the University of Maryland. LSG's share of the research funding is $740,000.

The project will explore whether robots and drones can be used in traditional on-bottom oyster culture. "Right now, crop management is accomplished by dredging a reef or using a cane pole to poke around and see if you hit a hard spot (group of harvestable oysters)," Callam said. Dredging is generally imprecise and can have negative environmental impacts, even for the oyster crop. Although the cane pole method is more precise in finding clusters of oysters, it's time consuming and labor intensive.

Through the use of robots, drones, high-precision GPS, underwater imaging and sonar positioning, the researchers hope to develop precision oyster grow-out and harvesting methods. The high-tech gear would map water bottoms where oysters are growing and help in determining when and exactly where the oysters are ready for harvest – streamlining the harvesting process. The technology could also be used to seed oyster reefs.

Callam's part of the in the project is to collect data on environmental conditions at oyster leases so that information can be fed into the robots. Then Louisiana field tests of the equipment will take place.

More Secure Mooring Systems for Alternative Oyster Culture Researched

Despite deploying both recommended and mandated mooring methods, 2020's Hurricane Zeta caused extensive damage at some Louisiana Alternative Oyster Culture (AOC) operations, resulting in lost infrastructure and crops.

AOC is when oysters are grown in floating cages or in bottom-placed cages attached to pylons. This method allows the cages to be raised and lowered to protect oysters from predators, fouling, and ideally the effects of hazards like hurricanes.

A $75,000 research project initiated in January – funded by the National Sea Grant College Program – hopes to determine why some AOC moorings at Grand Isle failed and recommend possible solutions to prevent the problem from happening again. Navid Jafari, assistant professor of civil and environmental engineering at Louisiana State University (LSU), Brian Callam, director of the Louisiana Sea Grant (LSG) Oyster Lab and Voisin Oyster Hatchery on Grand Isle, and Rusty Gaudé, LSG and LSU AgCenter Marine Extension agent, make up the research team. Mississippi-Alabama, Texas and Florida Sea Grant personnel also are planned participants in the project.

LSG's Alternative Oyster Culture demonstration farm on Grand Isle.

The team already has met with Grand Isle oyster growers to learn more about the mooring systems used and how they were installed. They're also looking at the geology of the area and the variability of the soil properties at different water depths.

Field testing of possible mooring solutions will take place through early 2022, with recommendations to growers available by the 2022 hurricane season. Monitoring of the test mooring systems, however, will continue through December 2022.

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Please send change of address, subscription requests, and correspondence to *Coastal Clips*, Louisiana Sea Grant Communications Office, Louisiana State University, Baton Rouge, LA 70803. (225) 578-6564. *Coastal Clips* is published four times a year. Subscriptions are free upon request. Visit us online at *www.laseagrant.org*.

NUMBER 55
SUMMER 2021

Coastal Clips

Louisiana Homeowners Handbook to Prepare for Natural Hazards

The Louisiana Homeowners Handbook to Prepare for Natural Disasters helps residents prepare for natural hazards so that risks to family and property might be reduced. While it is never possible to eliminate all potential damage from a natural hazard, homeowners and tenants can take action and implement many small and cost-effective steps that could significantly lower their vulnerability.

Available as a free download, the handbook was updated in 2020. To download a copy of the book visit: *www.laseagrant.org/wp-content/uploads/LA-Homeowners-Handbook-2020.pdf*.