ACCOMPLISHMENTS

Sea Grant
Mississippi-Alabama

Accomplishments reported
by Mississippi-Alabama Sea Grant
Feb. 1, 2017-Jan. 31, 2018

Accomplishments

Healthy Coastal Ecosystems

Resilient Communities and Economies

Sustainable Fisheries and Aquaculture

Environmental Literacy and Workforce Development

Cross-cutting

Healthy Coastal Ecosystems

National Water Extension Program developed to facilitate evolution of water information for the United States

Relevance:
In the United States and around the world, water security is at risk. Too much water, too little water or water of poor quality endangers life, property, economies and ecosystems. These threats to water security arise from several factors, including increased water demand from population growth and weather- and water-related impacts of climate variability and change. They are intensifying, and risk is difficult to predict when coupled with the already complex natural water cycle.

Response:
The Mississippi-Alabama Sea Grant Consortium, the National Oceanic and Atmospheric Administration and The University of Alabama and have combined efforts to create the National Water Extension Program, based at The National Water Center in Tuscaloosa, Alabama. A national water extension liaison was hired to develop the program and foster collaboration among the organizations and with the communities and stakeholders who need water data and tools to help make decisions. The long-term goal of the program is to facilitate the delivery of resources that will allow communities and organizations to accurately and efficiently make vital short- and long-term planning decisions regarding the safety and security of their citizens and water resources.

Results:
A National Water Extension Liaison position was created, and the extension liaison developed a comprehensive plan of work. The liaison has worked extensively with program partners, and beyond, to improve communications, understand the most pressing issues and identify connections that will allow for the best leveraging of strengths to address water issues in the United States.

Recap:
A new National Water Extension Program was initiated to encourage collaboration among partners and facilitate the delivery of resources to help leaders ensure safety and security of their water resources and residents.

BOEM provides $1.6M to expand Sea Grant-developed tool that compares efficiency of coastal restoration projects

Relevance:
More than 1.2 million acres of coastal wetlands have been lost in the northern Gulf of Mexico in the past century due primarily to hydrologic modification and relative sea-level rise. Protecting and restoring the ecosystem services associated with these wetlands is the goal of state and federal restoration programs that have spent more than $2 billion on this crisis to date. Despite these expenditures, scientists and managers widely regard the scale of the crisis as beyond the budget available for restoration. Given this financial constraint, the need for efficiency is paramount when allocating limited funding amongst competing project needs.

Additionally, benefits transfer (the application of ecosystem-service values taken from a different location and/or habitat) continues to be a cheap, rapid and popular means of justifying project benefits, in spite of its many limitations and inappropriate uses.

Response:
The four Sea Grant programs in the Gulf of Mexico, NOAA and the Environmental Protection Agency's Gulf of Mexico Program funded economists who developed a method for measuring and comparing the aggregate flow of ecosystem service values (ESV) over time from alternative coastal restoration methods. The decision-support tool uses a Trajectory Economics Simulation Technique (TEST) based on a cost-benefit analysis framework. Project managers with the Louisiana Coastal Protection and Restoration authority (CPRA) supplied data for validating the ESV-TEST cost and benefit sub-models. In November of 2012, the draft tool was completed and presented to CPRA following a two-year developmental period.

Economists tested benefits transfer methods across two Gulf Coast locations (coastal Alabama and Louisiana), two geographic restoration scales (Gulf-wide and state-specific), three habitats (oyster reefs, salt marsh and black mangrove) and four ecosystem services (improved water quality, enhanced fisheries productivity, enhanced flood mitigation and bird habitat). Tests were conducted via surveys of 5,196 Gulf-Coast households to estimate the ecosystem service values of multiple Gulf Coast habitats. Overall, benefit transfer across habitats appeared to work well, whereas the appropriateness of benefits transfer across locations was more limited.

Results:
The economists developed ESV-TEST, a decision support tool for examining the comparative efficiency of coastal restoration projects under a time-dynamic, risk-dependent context. Scientists developed and tested the tool in Louisiana in 2012. In 2016, the Bureau of Ocean Energy Management (BOEM) provided an additional $1.6 million in funding to expand it to examine the efficiency of more than a $100M in pending state and federal coastal projects.

Recap:
Economists developed an ecosystem service value trajectory economic simulation tool (ESV-TEST) for multiple services, habitats and locations and determined that benefit transfer across habitats appeared to work fairly well along the Gulf Coast. The Bureau of Ocean Energy Management provided $1.6M to expand the tool.

Study determines that headwater wetlands improve water quality in coastal Alabama

Relevance:
There is a need to understand the role of headwater wetlands for maintaining coastal water quality and how land conversion may compromise these wetland functions. Modeling efforts that estimate the impact of land use are limited because they often do not account for wetlands. With increasing development pressures along the Gulf of Mexico, it is important that understanding wetland capabilities for water protection and measures to ensure these capabilities are realized is important.

Response:
Mississippi-Alabama Sea Grant-funded scientists demonstrated the importance of headwater wetlands to coastal water quality. Working with cooperation from the Weeks Bay National Estuarine Research Reserve, City of Foley and Faulkner State Community College, These data have been used to improve modeling forecasts of land use change effects available for area municipalities.

Results:
Project results showed that headwater wetlands substantially reduce the loads of soluble phosphorus and nitrogen. The field study results determined the capacity of headwater wetlands to reduce downstream nutrient loading. For example, up to 49-percent reduction in dissolved nitrogen was achieved by an urban wetland. This study will benefit local municipalities, land planners and other stakeholders looking to guide development to minimize water quality impacts.

Recap:
A Mississippi-Alabama Sea Grant-supported research study determined water quality improvements from headwater wetlands to improve watershed model predictions and guide future coastal development.

Scientists map submerged aquatic vegetation habitat, create plant identification website

Relevance:
Submerged Aquatic Vegetation (SAV) beds provide numerous ecosystem services, including nursery for juvenile stages of finfish and shellfish, an important food source to aquatic organisms and wading birds, sediment stabilization and wave energy buffering, and nutrient uptake and sequestration that mitigate eutrophication. There are several water quality/environmental models for seagrass/SAV habitat requirements. These models were developed based on long-term monitoring data. Application of the models by resource managers requires extensive/consistent water quality monitoring data, which limits their use to the areas with well monitored habitats. In addition, the conventional habitat models are often developed from classical regression methods, which makes it difficult to apply them in areas with complex landscape features.

Response:
Mississippi-Alabama Sea Grant-funded scientists surveyed the Mississippi and Alabama coasts for SAV distribution, location and species information. They made the information available in GIS, Google Earth and an Internet map (http://msaquaticmaps.byethost8.com/index.html). New Orleans, the cities of Biloxi, Ocean Springs and Moss Point in Mississippi and the Mobile Bay area in Alabama were engaged in the related field inventory and laboratory identification activities. A Mississippi Aquatic Plants identification guide website also was created and is available at http://jcho.masgc.org.

Results:
Dozens of organizations have used the Mississippi Aquatic Plants Website, and at least 50 have formally requested use of the information and/or photos provided on the website. The organizations include public education institutions, universities, outreach groups, herbariums and others from around the United States. In addition, project researchers co-edited the first-ever journal special edition about SAV research along the Southeastern United States that included all of the Gulf of Mexico states. The special edition was featured in the journal Southeastern Geography and elevated the awareness of SAV work and restoration needs throughout the region.

Recap:
Project creates the Mississippi Aquatic Plants Website and maps of submerged aquatic vegetation distribution, location and species information for Mississippi and Alabama.

Research enhances ability to determine bird migration stopover duration using weather surveillance radar

Relevance:
Most of the time and energy consumed by migrating land birds is during diurnal stopover to rest or refuel as opposed to migratory flights. Cumulative stopover duration among a series of stopover sites can have direct repercussions on spatiotemporal factors associated with migration success as well as carry over to other parts of the annual cycle. Most methods for determining stopover duration rely on repeated observations of marked individuals over time at an individual site at great expense and effort. However, weather surveillance radars provide data to determine stopover duration by observing unmarked individuals in aggregate over time at one or more individual sites with less effort and expense.

Response:
Mississippi-Alabama Sea Grant-supported researchers developed and are validating a new method integrating radar and field observations to determine a relative stopover duration for landbirds. This analysis compares the annual radar-estimated stopover duration index with the observed annual minimum stopover duration based on capture-recapture data of individual migrants at a passive mist-netting migration monitoring site across 14 years.

Results:
Positive correlations were found between the stopover duration index and observed minimum stopover duration. Integrating radar and ground data to derive a relative stopover duration index greatly expands the feasibility of comparing stopover duration across multiple sites in space or time in a cost-effective manner. Due to the success of this project, MASGC-supported researchers, the U.S. Fish and Wildlife Service and The Nature Conservancy are expanding the scope of this approach using additional funding. This new work will expand the number of validation sites and transform research to application of the model across the entire northern Gulf of Mexico.

Recap:
Estimating relative stopover duration for landbirds was improved through a new, less-expensive method that integrates radar data and field observations. Additional partners joined the effort to validate the model to cover the entire northern Gulf of Mexico for future management use.

Study documents first coupled radar, field observation data analysis for the northern Gulf to quantify impacts of severe weather events on fall bird migration

Relevance:
The Gulf of Mexico is a region that experiences some of the most severe weather events in the form of hurricanes – events that often coincide with the migration season of landbirds and can impact their stopover distributions. Over the last 20 years, during which time migration data have been collected at the Ft. Morgan migration station in Alabama, 25 tropical storms and 26 hurricanes impacted the northern Gulf Coast, and most occurred during fall passage. While forested habitats in close proximity to the Gulf allow individuals a last chance to refuel in autumn, these habitats are at odds with natural and anthropogenic disturbances. Hurricanes are a conspicuous type of natural event that can cause disturbance to stopover habitats and influence birds on migration.

Response:
MASGC-funded researchers examined the influence of hurricanes during autumn migration within the eastern Gulf of Mexico. Long-term banding data from coastal Alabama and remotely sensed data from the Mobile, Alabama, and Slidell, Louisiana, weather surveillance radars (WSR) were examined to determine how migrants respond to hurricanes. The WSR illustrated changes at a regional scale, while banding data provides a case study of species-specific changes in the stopover biology and habitat use of migrants.

Results:
Results at the regional scale suggest that migrants avoid hurricane impacted areas, possibly because habitat is degraded. At the local scale, many species decreased in abundance when comparing pre-storm and post-storm capture rates. Hurricanes impact species in different ways at multiple scales; and conservation plans should take these results into consideration as the frequency and severity of hurricanes are estimated to increase with climate change.

Recap:
A novel approach of coupling local-scale field data and large-scale radar data documented how severe storms adversely affect fall bird migration.

Research finds highly altered salt marsh habitats do not function as well as intact, natural salt marshes

Relevance:
The northern Gulf of Mexico, particularly coastal Mississippi, is undergoing rapid urbanization that may impact the habitat value of salt marsh ecosystems. As urbanization progresses in a manner that consumes natural habitats, the end result is the creation of a mosaic of smaller habitat patches, separated by an inferior or inhospitable matrix, from what was once a homogenous landscape (i.e., fragmentation). As salt marsh patches become progressively smaller and more isolated, they may be less suitable for the maintenance and regulation of nekton populations. Ultimately, the salt marsh reduction and isolation has the potential to disrupt the flow of energy and materials through salt marsh food webs leading to reduce trophic support in altered habitats.

Response:
From May through June 2010, Mississippi-Alabama Sea Grant-funded scientists collected autotroph, macroinfauna and nekton samples from salt marsh sites arrayed along a gradient of alteration from both the Biloxi Bay and Pascagoula River estuaries in Mississippi. They quantified the stable isotope ratios of carbon, nitrogen and sulfur for a subset of abundant species from these collections. The scientists used mixing models and isotope metrics to comparatively examine trophic structure in each of the sites.

Results:
Researchers conducted isotopic analyses on 194 autotroph, 147 macroinfauna and 646 nekton samples. Isotope mixing models and associated metrics indicated that both macroinfauna and nekton incorporated a narrower breadth of autotrophs into their diets in altered habitats compared to less-altered or natural habitats. Similarly, food-chain length appeared to be longer in altered salt marsh habitats. Overall, there was significant reduction in the isotopic niche of nekton assemblages in highly altered salt marsh habitats. The results of this work can be used to prioritize restoration sites within the Gulf of Mexico Region by identifying the best locations and design criteria for urban gradients (corridors) for terrestrial and living marine resources habitat.

Recap:
Mississippi-Alabama Sea Grant-supported research shows highly altered salt marsh habitats do not offer the same trophic support as intact natural salt marshes and, thus, the habitat values of altered salt marshes may be decreased for nekton populations.

Bottom-dwelling organisms provide indicators of coastal ecosystem health

Relevance:
Eutrophication-induced hypoxia represents a critical environmental issue facing coastal regions throughout the world, and especially in the northern Gulf of Mexico. Ocean warming threatens to synergistically exacerbate detrimental effects of hypoxia because rising temperature increases oxygen demands of organisms by ramping up their metabolism while directly lowering the solubility of oxygen in seawater.

Response:
In response to the societal need for better indicators of ecosystem health, Mississippi-Alabama Sea Grant-funded research contributed toward the development of mechanistic functional indicators that can be linked to the loss of ecosystem services due to hypoxia and ocean warming, through responses of benthic organisms exposed to combined levels of dissolved oxygen (DO) and temperature.

Results:
To develop a future mechanistic ecological indicator, Mississippi-Alabama Sea Grant-funded scientists improved a model platform based on ecophysiological processes for projecting population responses of key benthic species to interacting global stressors, including hypoxia and ocean warming. Experiments used key benthic polychaete species, including *Capitella teleta* and *Streblospio gynobranchia*, to provide data for tests of model platform assumptions. Scientists presented their research to 17 students and professionals at an expert workshop held at the 2016 Joint Gulf Estuarine Research Society/Society of Wetland Scientists Meeting in Pensacola Beach, Florida.

Recap:
As a proof-of-concept, scientists advanced the development of a future mechanistic indicator that can be linked to the loss of ecosystem services due to hypoxia and ocean warming.

Scientists develop tool that measures, compares ecosystem service values from alternative coastal restoration methods

Relevance:
More than 1.2 million acres of coastal wetlands have been lost in the northern Gulf of Mexico in the past century due primarily to hydrologic modification. Protecting and restoring the ecosystem services associated with these wetlands is the goal of state and federal restoration programs that have spent more than $2 billion on this crisis to date. Despite these expenditures, scientists and managers widely regard the scale of the crisis as beyond the budget available for restoration. Given this financial constraint, the need for efficiency is paramount when allocating limited funding amongst competing project needs.

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Response:
Economists developed a method for measuring and comparing the aggregate flow of ecosystem service values (ESV) over time from alternative coastal restoration methods. This decision support tool utilizes a Trajectory Economics Simulation Technique (TEST) based on a cost-benefit analysis framework. Data for validating the ESV-TEST cost and benefit sub-models were obtained from project managers with in the Louisiana Coastal Protection and Restoration authority (CPRA). In November of 2012, the draft tool was completed and presented to Louisiana Office of Coastal Protection and Restoration following a two-year developmental period.

Economists tested benefits transfer methods across two Gulf Coast locations (coastal Alabama and Louisiana), two geographic restoration scales (Gulf-wide and state-specific), three habitats (oyster reefs, salt marsh and black mangrove), and four ecosystem services (improved water quality, enhanced fisheries productivity, enhanced flood mitigation and bird habitat). Tests were conducted via surveys of 5,196 Gulf-Coast households to estimate the ecosystem service values of multiple Gulf Coast habitats. Overall, benefit transfer across habitats appeared to work well, whereas the appropriateness of benefits transfer across locations was more limited.

Results:
Economists at Louisiana State University and Mississippi State University developed ESV-TEST, a decision support tool for examining the comparative efficiency of coastal restoration projects under a time-dynamic, risk-dependent context. Initially developed and tested in Louisiana, the tool is being expanded to federal applications Gulfwide, and has been critical in the leveraging of additional ESV-based funding totaling $1.6 million. ESV results were shared with practitioners at the 2012 Bays & Bayous Symposium, Biloxi, Mississippi; the 2013 National Forum on Socioeconomic Research in Coastal Systems, New Orleans; and the Mississippi Coastal Ecosystems Services Workshop “Using Remote Sensing to Quantify Ecosystem Services for Improved Coastal Decision Making” at the Grand Bay National Estuary Research Reserve, Moss Point, MS, 2018.

Recap:
Economists developed an ecosystem service value trajectory economic simulation tool (ESV-TEST for multiple services, habitats and locations and determined that benefit transfer across habitats appeared to work fairly well along the Gulf Coast.

Mississippi-Alabama Sea Grant contributes to national living shoreline conversations, educates policymakers

Relevance:
Bulkheads can cause habitat loss and degradation while living shorelines provide a green alternative. A recent analysis of shoreline hardening in the United States found that at least 14 percent or about 14,000 miles of the nation's shoreline is hardened. Despite growing interest in protecting natural shorelines, the regulatory framework for living shorelines is still evolving and varies at the federal, state and local levels.

Response:
In 2015, Restore America's Estuaries invited a Mississippi-Alabama Sea Grant Legal Program attorney to co-author a national assessment of living shoreline barriers and opportunities. Following the report release in 2015, the attorney served on the planning committee for the first national living shoreline summit held in December 2015. At the summit, she was a plenary speaker and talked to 265 living shoreline practitioners about the unique challenges and opportunities of promoting living shoreline adoption through law and policy at the state and local levels. She also served as lead author for the summit proceedings report – "Living Shorelines: From Barriers to Opportunities." In June 2016, the attorney and two Mississippi-Alabama Sea Grant extension specialists co-hosted an outreach event on living shorelines that targeted Alabama elected officials.

Results:
Mississippi-Alabama Sea Grant's living shoreline work raised awareness of living shorelines among decisionmakers at all levels of government. Eighty-four percent of attendees at the June 2016 workshop indicated that they learned something they would apply in their work or future decisions. Forty-six percent of attendees reported that the workshop increased their understanding of living shorelines "a great deal." One of the attendees of the June 2016 workshop, Rep. Bradley Byrne (R-AL), is a co-sponsor on the Living Shorelines Act of 2017 (H.R. 4525).

Recap:
Mississippi-Alabama Sea Grant contributed legal expertise to national reports identifying opportunities to encourage living shorelines, organized a statewide workshop and helped decisionmakers increase their knowledge of living shorelines.

Online ecosystem services viewer shows values for services provided by Gulf of Mexico marshes, mangroves and oyster reefs

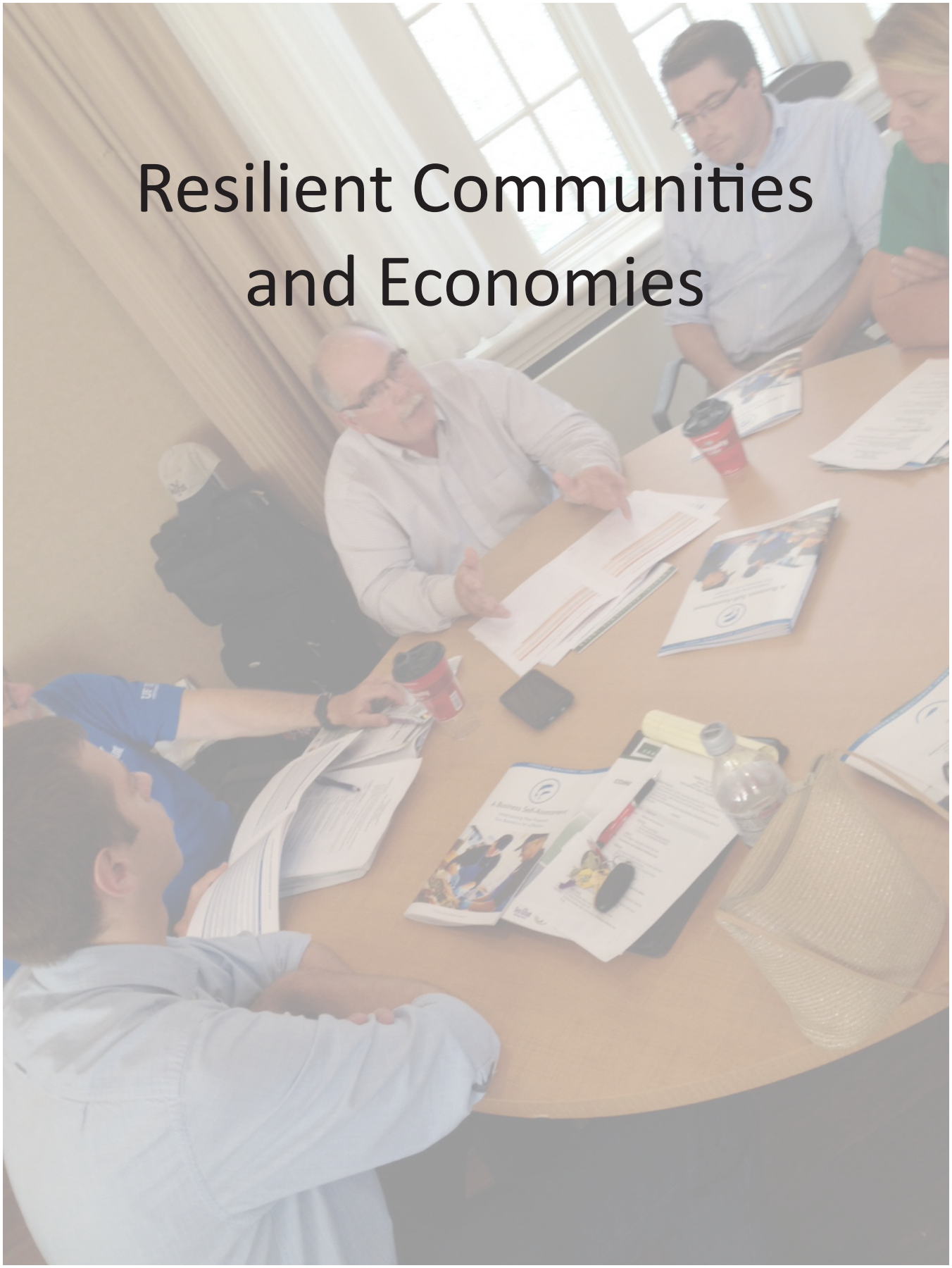
Relevance:
A healthy and resilient Gulf of Mexico guarantees the continuous provision of ecosystem services and benefits to people (e.g. provision of food and clean water, protection against storms and flooding, etc). To manage these natural resources, quantification and valuation of ecosystem services is needed so that more sustainable decisions can be made. Currently, the benefits provided by the environment, known as ecosystem services, and their impacts on human well-being are rarely accounted for, if at all, at the local, state, regional and federal levels.

Response:
Scientists planned and developed an online Gulf of Mexico Ecosystem Services Viewer (or GecoView - at http://gecoview.org). The tool is an interactive story map about coastal ecosystem services that oyster reefs, salt marshes and mangroves provide. The tool values and quantifies preferred ecosystem services in monetary terms.

Results:
Gulf-specific values for defined ecosystem services related to oyster reefs, mangrove, salt marshes and ecological management sites are available on GecoView (gecoview.org), the Gulf of Mexico Ecosystem Services Viewer. The viewer provides passive use values for salt marshes, mangroves and oyster reefs in each Gulf of Mexico state. The site also offers carbon sequestration, storm protection, food and raw material valuations where appropriate. GecoView is on the GulfTREE (Tools for Resilience Exploration Engine) website as a tool. Additionally, the Mission-Aransas NERR used GecoView to make their Natural Capital flyer, which discusses the value of wetlands, specifically in Texas. It was featured on the Gulf of Mexico Climate Outreach Community of Practice Monthly Tool Bulletin- Volume 2, Issue 2: February 2016. Since GecoView was launched it has had 633 users and 883 page views. 41.86% from UK and 37.76% from USA, others include China, Canada, Germany, South Korea, Mexico, Brazil and Japan.

Recap:
GecoView, an online Gulf Mexico Ecosystem Services Viewer, places monetary values on ecosystem services provided by marshes, mangroves and oyster reefs in the Gulf of Mexico.

Resilient Communities and Economies



Maintained, expanded sea-level rise partnerships in the northern Gulf improve coastal resilience

Relevance:
Sea-level rise (SLR) is a critical hazard facing coastal ecosystems, communities and economies. Effective and efficient communication across the science-to-stewardship continuum is necessary for successful resilience. Encouraging coordination and discussion among researchers, clarifying research and facilitating appropriate tool application improves integration of science into decision-making. Fostering these relationships locally furthers place-based research application.

Response:
Translating SLR observations and research into decision-making is the goal of the Northern Gulf of Mexico Sentinel Site Cooperative, a Mississippi-Alabama Sea Grant Consortium-supported program. To achieve its goal, the cooperative encourages and facilitates productive communication and action within and between stakeholder groups and audiences (e.g., natural resource managers, researchers, extension agents). The cooperative's partners annually identify priority SLR gaps and needs across monitoring, science and management. The cooperative's staff take on a variety of roles and efforts to support actions that address these priorities and connect local and regional SLR stakeholders. These can include coordinating and leading conference calls, newsletters, emails, workshops and webinars; seeking additional funding; developing products; and coordinating and managing projects.

Results:
The cooperative's partners identified priority gaps and needs in sea-level rise science and management along the Gulf of Mexico for the collective partnership to address. Priority gaps and needs that were been prioritized and addressed include: SLR observing infrastructure inventories and gap analyses; recommendations to decision-makers on how to use available information, especially tools; consistent SLR scenarios for modeling in the northern Gulf; strategic placement and development of SET sites to address gaps; improved outreach and communication for SLR science and issues at the local and community level; and communicating the socioeconomic cost of not adapting to SLR. The cooperative staff and partners took actions to address these gaps and needs guided by workplans the cooperative management team developed. Additionally, there is now a clearly accessible network of sea-level rise experts and research to facilitate community planning and resource management.

Recap:
The Northern Gulf of Mexico Sentinel Site Cooperative, a Mississippi-Alabama Sea Grant-supported program, strengthened partnerships and increased awareness and access to relevant sea-level rise research and tools to increase resilience in coastal communities and economies.

Northern Gulf of Mexico Sentinel Site Cooperative identifies sea-level rise models, tools and improves access and application

Relevance:
In the northern Gulf of Mexico, stakeholders are feeling overwhelmed by the number of available tools and models for understanding sea-level rise and sea-level rise related effects on the natural and built environment. They are unsure how to select the right tool for the issue they are trying to tackle.

Response:
The Northern Gulf of Mexico Sentinel Site Cooperative, a Mississippi-Alabama Sea Grant Consortium-supported program, and other partners developed resources to improve access to and understanding of available climate change models and tools. They strategically integrated stakeholder input throughout project development. The two primary resource were “Keeping Pace: A short guide to navigating sea-level rise models” and “Gulf TREE (Tools for Resilience Exploration Engine)”. These resources help stakeholders and decision-makers understand why model selection is important, need-to-know concepts for selecting models and ways to determine which model or tool is best for their needs.

Results:
“Keeping Pace” and “Gulf TREE” were well received and frequently utilized. Over 1,000 print materials about the resources were distributed. Gulf TREE (http://gulftree.org), in 2017 and has had over 1,400 site visit s and is gaining national recognition for its functionality and unique approach to model and tool selection. The Keeping Pace webpage (http://masgc.org/northern-gulf-of-mexico-sentinel-site-co/keeping-pace) had 780 pageviews since its creation in 2016 and is used in every USGS engagement and education workshop to teach people about SLR models.

Recap:
The Northern Gulf of Mexico Sentinel Site Cooperative, a Mississippi-Alabama Sea Grant Consortium-supported program, developed resources to help stakeholders access and apply sea-level rise tools.

Northern Gulf of Mexico Sentinel Site Cooperative identifies gaps, needs in sea-level rise observing infrastructure to improve data application

Relevance:
Understanding elevation of surrounding habitat, sea level and land is critical to understanding local sea-level rise and its impact. For example, elevation of habitats in relation to sea level is directly related to health and extent of coastal habitats. Surface elevation tables (SETs), when coupled with marker horizons, track elevation and provide information on subsidence, accretion, uplift and erosion in wetland habitats. Obtaining baseline data and understanding shifts in these trends over time will provide insight for management to best protect natural and built environments. However, a variety of owners manage these installations making it difficult to gain a holistic understanding of current data coverage and any critical gaps.

Response:
The cooperative's partners identified priority observing methods in need of inventory and analysis to understand gaps and opportunities: 1) Surface Elevation Tables (SETs); 2) Continuously Operating Reference Stations (CORS). SETs in the Gulf were inventoried in 2015, and, in 2016, the NOAA Gulf Regional Collaboration Team and the U.S. Fish and Wildlife Service partnered to support interns to conduct a gap analysis of SETs and an inventory of CORS. Stakeholders and practitioners were integrated throughout both efforts, resulting in: a geospatial analysis highlighting areas that could be used to efficiently address the most gaps in SET coverage; an understanding of existing CORS, regardless of operator; a report identifying gaps and opportunities between CORS and tide stations; and, online access to developed materials.

Results:
Access to available data is more efficient and comprehensive. The SET inventory was complete and has been downloaded 19 times. It is also included in five public data galleries. The gap analysis has been used to validate use of funding and resources. The CORS inventory and analysis has been used to save time and effort, increasing ability to focus on more critical things. More than six partners have utilized the CORS inventory to understand the available information, enhance networks and improve data access.

Recap:
Inventories and gap analyses of SLR observing infrastructure improved comprehensive access to data critical for describing and understanding SLR in the Gulf of Mexico.

The Northern Gulf of Mexico Sentinel Site Cooperative leverages project to better understand stakeholder needs, perceptions

Relevance:
Capturing perceptions and needs of local elected officials and municipal staff around sea-level rise (SLR) is critical to developing tools and science to improve SLR resilience and preparedness. Despite the importance of this information, it can often be difficult to obtain for many reasons including political will, schedule demands, and overall interest in the topic.

Response:
The Northern Gulf of Mexico Sentinel Site Cooperative, a Mississippi-Alabama Sea Grant-supported program, has been working with a committee partially made up of local elected officials and municipal employees to identify their SLR needs and perceptions and to fill gaps where appropriate. The committee is part of a project funded by the NOAA RCRG to develop case study videos around SLR resilience.

Results:
The work is still ongoing, but already helpful information has been obtained. This includes understanding barriers to integrating SLR into ongoing municipal work, understanding what SLR tools are most effective and why, what aspects of case studies are the most compelling for different audiences and around different types of projects (infrastructure, planning, or data collection), which visualization techniques are the most effective at communicating SLR and future conditions. Additionally, it has been a mechanism of further educating these often-elusive stakeholder groups about future conditions.

Recap:
The Northern Gulf of Mexico Sentinel Site Cooperative has been able to utilize monthly virtual meetings to better understand local elected officials and municipal employees' perceptions and needs around SLR in the northern Gulf of Mexico.

Mississippi-Alabama Sea Grant leads efforts to develop homeowner's handbooks to help Gulf residents prepare for natural hazards

Relevance:
While it is never possible to avoid all damage from a natural hazard, homeowners can take action and implement small, cost-effective steps that can prepare their property and families to reduce risk.

Response:
Mississippi-Alabama Sea Grant coordinated all efforts to publish an Alabama version and a Mississippi version of the Homeowner's Handbooks to Prepare for Natural Hazards. Mississippi-Alabama Sea Grant staff identified technical experts, coordinated technical reviews and edits, and worked with printers and designers to create the state-specific Mississippi and Alabama handbooks, which were based on Hawaii Sea Grant's original version of the handbook. Funding from NOAA's Coastal Storms Program provided funding to print the books. Additionally, the handbooks contained helpful tips on creating preparedness plans and how to correctly incorporate advanced residential building methods, such as retrofitting the roof system with hurricane clips, to increase resilience and strengthen homes.

Results:
Over 10,000 copies of the two Homeowner's Handbooks were distributed to residents and businesses in Mississippi and Alabama. Because of the success of these two handbooks, Mississippi-Alabama Sea Grant was able to coordinate the development efforts for similar handbooks in Florida, Louisiana and Texas. Copies of the handbooks, funded by the Gulf of Mexico Alliance Resilience Team, were distributed at conferences, workshops and local home improvement stores. Local municipalities that participated in the Community Rating System (CRS) distributed some of the books and received outreach points that counted toward their community's CRS score.

Recap:
Mississippi-Alabama Sea Grant led the development of state-specific Homeowner's Handbooks to Prepare for Natural Disasters for each of the five Gulf states.

Researchers discover factors (including distance to waterfront) drive land values in coastal Mississippi and Alabama

Relevance:
Open space near waterfront areas provides ecological benefits and opportunities for recreational activities. With a growing population, increasing demand for these areas often leads to conflicts in proposed land uses. It is critical to consider the benefits of waterfront open space in areas where the conversion of open space into developed land uses is extensive.

Response:
Mississippi-Alabama Sea Grant-supported scientists applied a unique approach to understand values of coastal urban areas and growth by using data from various sources including the U.S. Census Bureau, Mississippi Automated Resource Information System (MARIS), USA.com, data.gov, expertGPS and cityofmobile.org. Data on house structural and socioeconomic characteristics were collected at the census block group level. GIS shape files, point data and waypoints were collected from the U.S. Census Bureau, MARIS, cityofmobile.org, and expertGPS. Definitions of variables were also used. A hedonic pricing method (HPM), a widely-used nonmarket valuation technique, was used to quantify waterfront open space value.

Results:
Scientists used 25 variables in estimating a HPM model. Parameter estimates on most of the variables, 22 out of 25, were significant at 10 percent or better level of significance. Almost 67 percent of the variation in the model was due to explanatory variables such as school, hospital and home amenities, and distance to waterfront. Distance to specific waterbodies was especially important. For example, in Mobile, as homes became closer to creeks, rivers and bays, the sale price increased between 0.03 percent and 0.04 percent. Homes closer to bayous increased values by 0.07 percent.

Recap:
Estimated monetary values of waterfront land use in coastal counties of Mississippi and Alabama consistently had positive economic impact on housing price.

Citizens conduct urban tree inventories in four coastal communities

Relevance:
Together, urban trees make up the urban forest, which provides a wide variety of goods and services including aesthetics, wildlife habitat, recreational opportunities, urban heat island reduction, air quality improvements, stormwater runoff amelioration, energy use reductions, exercise opportunities, a place to relax and potential increased real estate values. It is critical to consider the benefits of the urban forest, particularly in places characterized by increasingly land consumptive development patterns, such as those in the Gulf Coast. Further, international and national initiatives and policies, such as Agenda 21, demand an accounting of the urban forest resource for planning and management purposes. To this end, urban trees must be inventoried and assessed for costs and benefits.

Response:
During 2015, four urban inventories were implemented to educate residents and provide data to communicate the important benefits urban trees provide – in economic terms – to communities. Inventories took place in Fairhope and Orange Beach in Alabama and Pass Christian and Long Beach in Mississippi for this Mississippi-Alabama Sea Grant-funded project.

Results:
Each inventory consisted of at least 200 one-tenth-acre sample plots using the U.S. Forest Service's i-Tree protocol. A smart phone application called TreeMetrics was developed to collect information on tree and site characteristics. Resident volunteers spent three to six months (over 4,000 hours) collecting the data estimated ecosystem services values for 853,500 trees, or 49.6 percent of the combined land area, storing $224 million of carbon and almost $1 million in building energy savings.

Recap:
For the first time, urban forest inventories were conducted by citizens in four communities along the Mississippi-Alabama Gulf Coast.

Interviews, surveys provide baseline data on knowledge about benefits of urban forests

Relevance:
Continued population growth is placing increased pressure on natural resources and presenting significant management challenges. This is unfortunate because local forests and other coastal ecosystems provide natural storm buffers to coastal human communities. Coastal communities can increase their resilience by improving and maintaining their urban forests through planning and management. However, successful, long-term planning and management necessitate having baseline data as the foundation for decision-making.

Response:
Mississippi-Alabama Sea Grant-funded scientists conducted 75 key informant interviews (in Pass Christian and Long Beach in Mississippi and Orange Beach and Fairhope in Alabama) for qualitative analysis and a mail survey to assess public values, attitudes and behaviors regarding Gulf Coast urban forests. A survey was distributed to 2,000 households in the study sites. Four workshops also taught residents how to identify trees, measure structural characteristics, use geographic positioning system tools and assess urban tree hazards. In, order to educate residents and provide data to communicate the important benefits urban trees, four urban tree inventories were organized. An urban tree inventory app was made available through the App Store (Treemetrics).

Results:
Interview findings suggested moderate knowledge of the benefits of urban forests among leaders. By contrast, most informants indicated the general public had very little awareness of urban forest ecosystem services. This is consistent with a general population survey (N=2,000) of residents, which indicated a strong appreciation of urban trees, but little knowledge of their values as storm buffers and limited direct involvement in efforts to improve coastal ecosystems. The app has been downloaded 3,320 times over three years.

Recap:
Citizen engagement increased environmental literacy and provided baseline data to communicate the value of urban forest ecosystem benefits.

Scientists use SWAT Model to predict effect of land use/land cover changes on water quality; results incorporated into a watershed management plan

Relevance:
The Fish River is coastal river that is located in southwest Baldwin County, Alabama. Fish River is the primary freshwater source for Weeks Bay, one of only three Outstanding National Resource Waters in Alabama and home to the Weeks Bay National Estuarine Research Reserve. The Fish River watershed is rapidly urbanizing. Changes in land use and cover, especially urbanization, are known to adversely impact water quality and quantity in watersheds. Establishing the linkage between the water quality and land use cover types in a given area is crucial for sustainable future development.

Response:
Mississippi-Alabama Sea Grant Consortium-funded researchers investigated whether the Soil and Water Assessment Tool (SWAT), a public domain model jointly developed by the U.S. Department of Agriculture's Agricultural Research Service and Texas A&M AgriLife Research, could be used to predict variations in water quality/quantity due to alterations in land use/land cover (LULC) over time in the Fish River watershed.

Results:
The SWAT model was shown to be reliable tool in predicting the water quality impacts of land use and land cover change. To convey these results, the researchers held a workshop and a charrette in the city of Fairhope, Alabama. The workshop included (1) information on the state of the Fish River Watershed, water quality data and SWAT watershed modeling; (2) an overview on green policy in Baldwin County in comparison to federal and state levels; and (3) information on LID model policy and design, and economic benefits of protecting trees during development. Several city and county officials attended the workshop, and knowing how to properly communicate modeling information serves as a useful tool in promoting a new LID policy. The results from this project were incorporated into the Week's Bay Watershed Management Plan, and the model is being coupled with a water quality model for expanded use.

Recap:
Week's Bay Watershed Management Plan incorporates Mississippi-Alabama Sea Grant-funded research results. The study also enabled prediction of the effects of land-use/land-cover change on water quality in the Fish River watershed in Alabama.

Gulf of Mexico Sea Grant legal research informs judicial analysis

Relevance:
The Fifth Amendment of the U.S. Constitution states that private property may not be taken for public use without just compensation. In 1922, the U.S. Supreme Court ruled that a regulation that goes "too far" amounts to a taking. Federal and state courts have been struggling to figure out when a regulation goes "too far" for the past 80 years. Takings claims involving the regulation of coastal property have proven particularly challenging for courts due to the intersection of private and public rights in the coastal zone. Because the law in this area is complex and evolving, state and local governments are reluctant to enact new laws and regulations to address ongoing and emerging coastal hazards, which increases the risk of future environmental and social harm.

Response:
In 2010, the Mississippi-Alabama Sea Grant Legal Program and project partners Florida Sea Grant, Louisiana Sea Grant Law and Policy Program, Harte Research Institute for Gulf of Mexico Studies and Texas Wesleyan School of Law launched a legal research and outreach project on the impact of the "regulatory takings" doctrine on the ability of local governments to implement sea-level rise adaptation policies. The Gulf of Mexico Sea Grant Programs, the Environmental Protection Agency Gulf of Mexico Program and the Northern Gulf Institute funded the work. The project team conducted in-depth legal research on a range of legal issues and produced five law review articles that were published in the Journal of Land Use & Environmental Law in 2011.

Results:
The project team's research is informing the legal debate regarding the impact of the takings doctrine on state and local coastal management decisions. The five articles have been cited 68 times. The articles were cited in cases and pleadings (5), law review articles (41), legal treatises (5), scientific journals (10) and reports and books (7). In a high-profile Texas regulatory takings case, Severance v. Patterson, involving the Texas Open Beaches Act, a dissenting judge cited one of the project team's law review articles seven times to support his argument that the majority was not adequately considering the potential environmental impact of its ruling.

Recap:
The Mississippi-Alabama Sea Grant Legal Program and project partners conducted legal research on the impact of the regulatory takings doctrine that informed the legal debate regarding the Texas Open Beaches Act.

City of Fairhope completes Coastal Community Resilience Index, wins funding for resilience projects

Relevance:
Mississippi-Alabama Sea Grant created the Coastal Community Resilience Index, which is a self-assessment that helps communities identify their vulnerabilities to coastal storms. Completing the Coastal Community Resilience Index to determine existing strengths and weaknesses often is the first step cities take toward developing and implementing strategies to become more resilient.

Response:
Mississippi-Alabama Sea Grant and Smart Home America helped City of Fairhope (Alabama) staff complete the Coastal Community Resilience Index and receive new funding and technical assistance to address vulnerabilities they identified. The first source of funding was the Gulf of Mexico Alliance's Small Community Grant Program (a NOAA Regional Coastal Resilience Grant award). The second source was a U.S. Environmental Protection Agency (EPA) "Connecting the Dots" grant competition. Fairhope partnered with Mississippi-Alabama Sea Grant to receive funding for a waterfront resilience project through the EPA competition

Results:
As a direct result of Mississippi-Alabama Sea Grant activities, the City of Fairhope was able to successfully compete for funding of new projects to reduce risk and increase resilience. The city's projects include a community resiliency visioning and planning exercise, addressing stormwater vulnerabilities through GIS analysis, and working toward a Clean Marina designation to improve the city's working waterfronts.

Recap:
Mississippi-Alabama Sea Grant and Smart Home America staff facilitated the Community Resilience Index with the City of Fairhope in Alabama, which led to receiving funding for resilience-focused projects and technical assistance to address resilience-related vulnerabilities and opportunities.

Mississippi-Alabama Sea Grant and Smart Home America, a local non-profit with national reach, increase awareness of FORTFIED construction standards

Relevance:
Smart Home America's (SHA) vision is to create stronger, more resilient communities to withstand the forces of natural hazards. Mississippi-Alabama Sea Grant Consortium-supported staff at SHA began to address the need to include and enhance wind and flood insurance and mitigation information online and develop a more robust outreach capacity.

Response:
Mississippi-Alabama Sea Grant supported the development of SHA's website to share information about how to make homes more resilient. It also supported an outreach campaign titled "Don't Goof When You Re-Roof®." "Don't Goof When You Re-Roof®" encouraged people to use FORTIFIED Home™ resilient construction standards when they re-roof their homes. In addition, Mississippi-Alabama Sea Grant and SHA created a new, shared staff position to support the outreach capacity of both organizations to address wind and flood hazards. Mississippi-Alabama Sea Grant and SHA also led the Alabama Coastal Hazard Summit,

Results:
Mississippi-Alabama Sea Grant supported the creation of resources to increase residents' understanding about how to become more resilient to wind and flood events. The resulting "Don't Goof When You Re-Roof®" consumer outreach campaign generated more than 8,500 direct website impressions and more than 1.6 million digital and advertising impressions. A new shared staff position improved alignment of research and outreach activities, engagement of local stakeholders and adoption of enhanced mitigation strategies. Mississippi-Alabama Sea Grant and SHA also reached local building officials, insurance agents, builders, realtors, planners, floodplain managers, elected officials and outreach professionals to increase awareness of insurance and mitigation activities at the Alabama Coastal Hazard Summit, which they led.

Recap:
Mississippi-Alabama Sea Grant enhanced the capacity of Smart Home America and Sea Grant extension to address both wind and flood insurance and mitigation concerns in coastal Alabama, Mississippi and beyond.

StormSmart Coasts helps coastal decision-makers connect and collaborate

Relevance:
Coastal communities expressed the need for an easy way to share best practices, post current information to their constituents, and receive the latest news and trainings in their field.

Response:
StormSmart Coasts (http://stormsmartcoasts.org/) is a resource for coastal decision-makers looking for the latest and best information on how to protect their communities from weather and climate hazards. All five Gulf states have their own StormSmart site tailored to unique state needs. The Mississippi-Alabama Sea Grant Consortium and partners created StormSmart Connect, a social media network hosted by the StormSmart Coasts Network that helps coastal professionals find and share information on weather and climate hazards.

Results:
As of January 2018, there are 1,306 registered users with profiles and 138 visible groups. There have been approximately 70,000 users and 200,,000 page views per year over the last five years.

Recap:
An online web portal and professional networking site allows local decision makers to connect, communicate, and collaborate more effectively.

Gap analysis guides resilience strategies

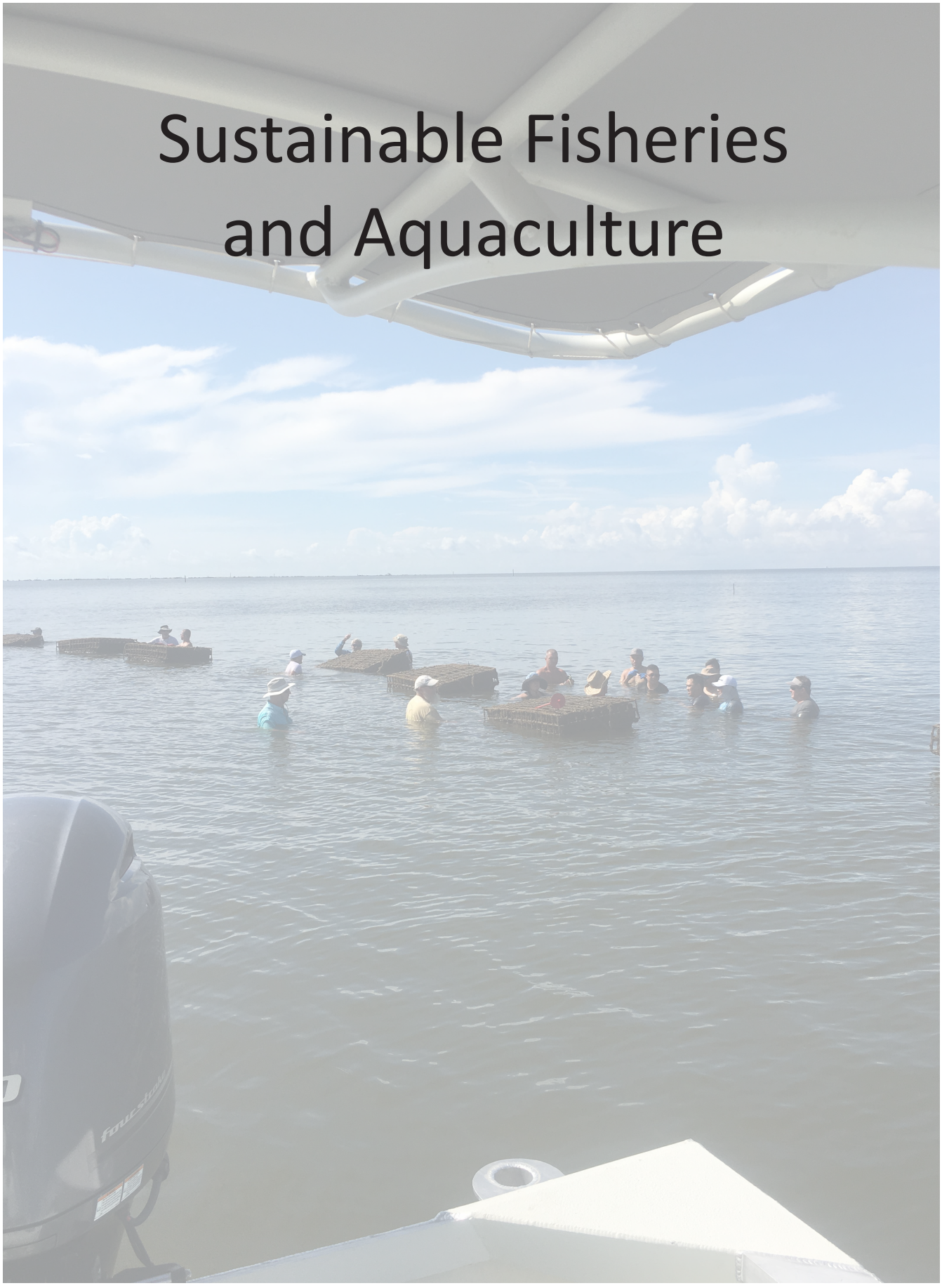
Relevance:
Many tools exist to help stakeholders make decisions about future growth and development in their communities. However, no tool covers the four domains of resilience (social, economic, built environment and natural environment), and tools do not exist in some domains. Communities need to know which tools have been tried and tested to answer relevant questions pertaining to sea-level rise, storm surge and future development.

Response:
Mississippi-Alabama Sea Grant Consortium (MASGC) funded researchers to design an online survey and conduct subsequent phone interviews to determine what tools and services stakeholders were using to guide resilience plans and actions. A total of 331 people in the Gulf of Mexico region completed the online survey, and 10 respondents participated in interviews to clarify survey results.

Results:
The gap analysis identified gaps in available tools and services. For example, stakeholders mentioned few tools in the economic and social domains of resilience. Survey respondents identified limitations of tools, actions they took as a result of using specific tools and needs that still existed to aid in decision making. Three fact sheets summarizing the important findings were created and results have been used to update three MASGC-funded resilience tools.

Recap:
MASGC conducted a resilience tools and services gap analysis, which was used to address needs for coastal communities.

Sustainable Fisheries and Aquaculture



Sea Grant's economic, legal expertise informs Mississippi Governor's Oyster Resource Resiliency Plan

Relevance:
In the last 10 years, Mississippi oyster harvests have dropped from over 400,000 sacks per year to about 70,000 sacks in 2014. During that time, the oyster reefs had been damaged significantly by Hurricane Katrina, the Deepwater Horizon oil spill and freshwater input from the Bonnet Carre Spillway opening.

Response:
Mississippi Gov. Phil Bryant created the Oyster Restoration and Resiliency Council in February 2015. The council included citizens, scientists and seafood industry leaders with a variety of interests and disciplines. Bryant appointed three Mississippi-Alabama Sea Grant Consortium Outreach Team members and the program's director to serve on the council's three committees (Oysters in the Economy, Oysters in the Environment and Aquaculture and Emerging Technologies). They were selected because of their expertise in economics and ocean and coastal law and policy. The council delivered its report to Bryant in June 2015.

Results:
The Council's Oyster Resource Resiliency Plan makes numerous near-term and long-term recommendations to enhance and sustain oyster production at 1 million sacks per year. The plan encourages bold but implementable management strategies, based on the sound research and reality-tested best practices. Mississippi-Alabama Sea Grant provided valuable information to committees, informing the development of final recommendations. The Mississippi Department of Marine Resources (DMR) has implemented or is in the process of implementing a number of the council's recommendations. It already has designated an oyster extension agent within DMR to facilitate and coordinate aquaculture and private leasing requirements, processes and activities.

Recap:
Mississippi-Alabama Sea Grant contributed expertise in economics and law and policy to the Mississippi Governor's efforts to enhance oyster production in the Gulf of Mexico.

Mississippi-Alabama Sea Grant seafood marketing outreach efforts connect consumers with local seafood

Relevance:
The Deepwater Horizon oil spill in April 2010 caused closures of significant portions of the Gulf of Mexico federal and Mississippi and Alabama state waters to commercial and recreational fishing. The closures altered seafood production and consumption decisions of residents and tourists in affected communities. Damaged natural resources caused changes in the market perceptions and flow of goods and services. The changes affected households as well as the seafood producers and service providers dependent on the natural resources. After the oil spill, the Gulf States Marine Fisheries Commission funded MarketMaker programs for each of the five Gulf of Mexico states via the Oil Disaster Recovery Program to help with economic recovery efforts for the Gulf seafood industry.

The Mississippi MarketMaker website went live in 2007, and the Alabama MarketMaker website went live in 2011. The sites offer Alabama and Mississippi fishermen, seafood processors, wholesalers, retailers and restaurants, charter boats for hire and farmers a free opportunity to connect with potential customers and establish networks with other producers online. The MarketMaker websites use an interactive mapping system coupled with a searchable database to locate producers and businesses with local products for sale.

Response:
Mississippi-Alabama Sea Grant conducted extensive outreach to familiarize producers with the tools and resources available through MarketMaker, developed and disseminated training materials through a biweekly online newsletter and social media networks, and conducted training workshops for producers, regulators and research/extension faculty and staff on how to create profiles and connect with producers and sellers.

Results:
The Alabama and Mississippi MarketMaker websites are available to all seafood businesses at http://al.foodmarketmaker.com and http://ms.foodmarketmaker.com. Since launching the MarketMaker websites, there has been an increase in the listing and registrations of online profiles for fisheries and marine-related establishments to 773 businesses and an increase in the number of web users to 62,125 users and web views to 122,847.

Recap:
Mississippi-Alabama Sea Grant led efforts to help 773 seafood producers, restaurants and other marine-related businesses use the free marketing online tool, MarketMaker.

Research determines anglers willing to adopt emerging technology to increase survival of non-targeted fish

Relevance:
Seasonal fishing closures and daily bag limits during open seasons result in substantial numbers of discards in the northern Gulf of Mexico recreational reef fish fishery. The Gulf of Mexico Fisheries Management Council is interested in adopting new rules to encourage use of emerging technology to improve survival of discarded fish. Descender devices have been proposed as a means to return discarded reef fish to depth to mitigate barotrauma and increase post-release survival, but little is known about the willingness of fishers to utilize descender devices.

Response:
A Mississippi-Alabama Sea Grant-supported researcher observed 53 charter fishing trips and interviewed 201 charter boat customers to assess anglers' attitudes toward releasing fish, using descender devices to release fish, and employing practices to minimize post-release mortality.

Results:
Overall, usage of the descender device was rare, but fishers had a positive view of descender devices and conservation in general, suggesting that recommendations or regulations for fishers to use descender devices to improve post-release survival of impaired reef fish warrants consideration by the Gulf of Mexico Fisheries Management Council. Descender device usage was highest for release of larger, severely impaired red snapper targeted during open-season fishing. Smaller red snapper caught during closed seasons were more likely to display outward signs of barotrauma but were rarely released with the descender device. In addition to filling a vital data gap, the researcher on this project increased awareness of the use of descender devices, making captains, deckhands and recreational fishermen interested in using these devices.

Recap:
Research finds that most charter fishing customers are amenable to releasing fish via descender devices, which may allow fish that would have otherwise died to survive and spawn or be caught again in the future.

Research shows descender devices improve survival of released red snapper

Relevance:
In the Gulf of Mexico, recreational fishers discard the majority of the red snapper (*Lutjanus campechanus*) and gray triggerfish (*Balistes capriscus*) they catch because it is caught out of season or does not meet size requirements. A significant proportion of these discarded fish suffer immediate or delayed mortality, contributing to wasted harvest and increasingly stringent management regulations to rebuild these overfished stocks. It is unknown if weighted return-to-depth (descender) devices could improve the survival of released red snapper and gray triggerfish and allow more released fish to survive and be available in the future for spawning or harvest. The Gulf of Mexico Fisheries Management Council is interested in adopting new rules to encourage use of this new technology to improve survival, but there is a lack of research to substantiate the effectiveness of this tool.

Response:
A Mississippi-Alabama Sea Grant-supported researcher examined the behavior and fates of acoustic transmitter tagged red snapper (n = 60) and gray triggerfish (n = 24) following catch and release within a 15 square kilometer array of acoustic receivers at 30 m depth in the northern Gulf of Mexico. This was the first-ever study to directly quantify the effects of releasing gray triggerfish with descender devices. It was also one of the first initial studies to directly quantify the effects of releasing red snapper with descender devices.

Results:
The descender device improved survival of red snapper when compared to fish released on the surface, suggesting that fishers can improve a fish's chance of survival by using a descender device. Predation by highly mobile predators accounted for the majority of discard mortality (86% of red snapper and 100% of gray triggerfish), which has not been observed in any other studies. Fishers may take actions to reduce predation mortality by using descender devices to release fish and by limiting the amount of time that they spend fishing on each reef. In addition to addressing a vital data gap, the researcher increased awareness of discard mortality and the use of descender devices among partnering charter boat captains and deckhands during this cooperative research project.

Recap:
Study shows that descender devices improve the survival of released red snapper, allowing fish that would have otherwise died to survive and spawn or be caught again in the future.

Scientists complete first ever age-structured integrated stock assessment of Alabama spotted seatrout

Relevance:
Spotted seatrout (*Cynoscion nebulosus*) are among the most targeted gamefish in northern Gulf of Mexico estuaries, including in Alabama and Mississippi, where inshore fishing is a vital component of the coastal economy and culture. The most recent stock assessment for Alabama spotted seatrout was outdated and was completed in 2007 with sparse data that limited the ability to perform a comprehensive stock assessment. Recent declines in catch rates of Alabama spotted seatrout raised concerns that the stock may be experiencing overfishing.

Response: A Mississippi-Alabama Sea Grant-supported researcher worked with fisheries biologists from the Alabama Department of Conservation and Natural Resources to compile detailed biological, catch and survey data and perform the first comprehensive age-structured (Stock Synthesis) stock assessment of Alabama spotted seatrout to date. The results of the stock assessment suggested that the stock is overfished and that unusually favorable environmental conditions (which may not persist indefinitely) have sustained very high harvest in recent years.

Results: The assessment findings were presented to fisheries biologists and managers at the Alabama Marine Resources Division (MRD) and shared with the agency as a comprehensive stock assessment report. Although managers chose not to modify recreational fishing regulations as a result of the findings, the stock assessment addressed a major data gap regarding Alabama spotted seatrout. The compiled data, models and findings of the stock assessment have been thoroughly documented and freely shared and will continue to be valuable to managers as the Alabama spotted seatrout stock continues to experience heavy exploitation and changing environmental conditions.

Recap: The first ever age-structured integrated stock assessment of Alabama spotted seatrout confirmed managers' concerns that stock biomass has been reduced to levels indicative of overfishing.

Program helps stakeholders understand marine fisheries research, management issues

Relevance:
Healthy fisheries are fundamental to the cultural and economic well-being of northern Gulf of Mexico residents, yet overfishing, habitat loss and changing environmental conditions threaten the sustainability of these resources.

Response:
The Mississippi-Alabama Sea Grant Consortium/Mississippi State University Marine Fisheries Ecology Program was formed in late 2017 to extend regionally relevant, science-based research findings to commercial and recreational stakeholders across the coastal regions of Mississippi and Alabama. Mississippi-Alabama Sea Grant had been without a fisheries specialist for 1.5 years due to the retirement of a longtime extension specialist. The members of the revamped program attended fishing and boat shows and other events to make the program more visible and increase its stakeholder audience. They also post Mississippi-Alabama Sea Grant blogs and have created a Facebook page (@marinefisheriesecology). The program also participated in the Gulf of Mexico Shrimp Fishery Improvement Project (FIP), which is designed to bring together multiple stakeholder groups (fishers, managers, researchers) to promote sustainable seafood practices in the Gulf of Mexico shrimp industry.

Results:
Nearly 200 anglers received fisheries information monthly through the Marine Fisheries Ecology Program's new e-newsletter, "Gulf Coast Fisherman." In addition, 120 people are following the program's Facebook page to receive fisheries management and research information.

Recap:
By engaging with stakeholders in Mississippi and Alabama, the Marine Fisheries Ecology Program extended research findings to ensure sustainable commercial and recreational fisheries.

Study validates oyster larvae transport model using calcein-marked oyster larvae

Relevance:
Very little research has been done to develop reliable methods for tracing larval movements in estuaries. These data are necessary to inform management and restoration and to validate hydrodynamic models that address mass. These data are particularly important for the Mobile Bay/Mississippi Sound system, which is freshwater dominated and the location of one of the only remaining viable natural commercial stocks of eastern oysters.

Response:
Mississippi-Alabama Sea Grant-funded scientists conducted field sampling for oyster larvae marked with calcein (a fluorescent dye) and unmarked and applied the field data to validate an existing oyster larval transport model. The model was run using four different simulations: lower and higher salinity with updated physical parameters only or with physical and biological (oyster size/swimming speeds) parameters.

Results:
The model was sufficiently predictive to allow scientists to recover marked oysters after open water release. Marked oysters were recovered at locations where and times when unstained oysters also were most abundant. At higher salinity, when marked oysters were recaptured, scientists found that the model under-estimated (by about 3 days) the rate of larval dispersal from Mobile Bay to Mississippi Sound, regardless of whether physical attributes were used alone or in combination with biological data. The model, however, predicted higher concentrations of larvae at recovery sites when biological attributes were included. Lower salinity conditions in the field resulted in nearly zero larvae of any kind (stained or unstained) retrieved. Accordingly, the model predicted lower concentrations of larvae during the lower salinity period. Overall, these data demonstrate that the model captured major larval movement patterns. Additional refinement is needed to continue to best align field observations with model outputs. The data suggest swimming speed and/or flow at the confluence of Mobile Bay and Mississippi Sound were underestimated during the validation study. The approach can be used to predict the timing and relative number of oyster larvae moving through the Mobile Bay and Mississippi Sound system under different physical and biological conditions. One methods-based manuscript is in preparation.

Recap:
The model predicted major movements of marked oyster larvae, with an offset of about 3 days between model predictions and field-recovery of larvae (oysters moved faster than predicted). Researchers at NOAA and Roger Williams University intend to apply this method and these results to a similar study in the Chesapeake Bay area. Another researcher has interest in tracing larvae in the Galveston Bay area.

Scientists develop, apply hydrodynamic model for Mobile Bay, Mississippi Sound systems

Relevance:
Understanding the dynamics of water movement and the resulting physical mass transport is critical for the study of the fate and distribution of materials. Credible hydrodynamic models are needed to perform a wide range of society-critical applications, including management, event-based forensic studies (hindcasts), event-based forecasts, design and risk assessment. A robust model is needed to inform adaptive and ecosystem-based management of fisheries and water quality.

Response:
Mississippi-Alabama Sea Grant-funded scientists refined a hydrodynamic model for the Alabama/Mississippi coastal waters including the Mobile Bay/Mississippi Sound system and validated the model using data for water level, current velocity and salinity/temperature. They then validated the model to quantify flushing characteristics and circulation patterns in the system.

Results:
Scientists produced two peer-reviewed papers (one currently in revision, one in prep) and created and submitted metadata for the up-to-date model to the Dauphin Island Sea Lab Data Management Center (DMC), Zenodo research data repository and NERC Model Metadata interface, which are central repositories for modeling and other metadata that can be publicly searched and have links to the freely accessible model code. Model code is archived and available on request from the Dauphin Island Sea Lab DMC (http://cf.disl.org/datamanagement/metadata_folder/DISL-Park-EFDC_model-001-2018.html). Meta-data can be found on Zenodo (https://doi.org/10.5281/zenodo.1252355). Data have not been assigned a link at NERC.

Recap:
A hydrodynamic model for water level, current velocity, salinity and temperature for Mobile Bay was expanded to include Mississippi Sound, and model meta-data and code are available to the public.

Study increases understanding of wastewater's influence on local oyster farms, reefs

Relevance:
One application of the hydrodynamic model is to test for the influence of wastewater on native and aquacultured shellfish stocks. Water quality issues pose a significant threat to harvest of wild oyster stocks and continued expansion of the oyster farming industry on the Mississippi-Alabama coast. Currently more than 33,000 acres of the Mobile Bay and Mississippi Sound system has restrictions on shellfish harvest due to public health concerns related to water quality.

Response:
As part of leveraged funding through the Dauphin Island Sea Lab-U.S. Food and Drug Administration joint fellowship program, scientists provided additional data beyond the original project scope. For this additional output, scientists compared their data on movement and distribution of oyster larvae to data on concentration of bacterial and viral indicators. They also sampled nearby rivers and wastewater treatment plant outfalls to determine the major sources of pathogens to areas where shellfish were found.

Results:
Oysters primarily settle in the Mississippi Sound, where bacterial and viral indicators are typically found at lower concentrations than in Mobile Bay. The Mobile River was a greater source of pathogen indicators to Mobile Bay than the nearby major wastewater treatment plant, except when river flow was unusually low and wastewater outputs were high. Scientists have already shared these data with Mississippi-Alabama Sea Grant oyster specialists, the Mobile Bay National Estuary Program and others, including the Alabama Department of Conservation and Natural Resources, Alabama Department of Public Health, Alabama Department of Environmental Management, Department of Agriculture representatives, and local watermen and aquaculture specialists as part of the West Fowl River Water Quality Management Plan in development. Scientists continue to work with these end-user groups to apply their data and the hydrologic model to predict effects on water quality and shellfish resources in the region.

Recap:
Data on oyster and pathogen co-occurrence are being used to better understand the influence of wastewater on local oyster farms and oyster reefs.

Linkages among urbanization, human health and ecology enhance detection of contaminated shellfish across two states

Relevance:
As urbanization continues to increase within coastal communities, wastewater discharged into coastal waters increases as well. The inputs of nutrients and pathogens associated with wastewater can adversely impact coastal and estuarine ecosystems, including oysters. In addition, harvesting areas for oysters and other shellfish may be closed due to human health concerns. The fecal coliform indicators that are traditionally used to determine if oysters are safe for human consumption are not always accurate, and there are opportunities to improve approaches to assess the status of oyster habitat and fishing areas.

Response:
Mississippi-Alabama Sea Grant-funded researchers partnered with the U.S. Food and Drug Administration and others to examine the relationship between sewage outfalls, ecosystems health and oyster growth and survival. In Mobile Bay, Alabama, they sampled locations near and relatively far from sewage outfalls and collected oyster tissue samples to determine wastewater influence on oyster habitat and biology. In addition, they tested two newly coupled indicators: nitrogen stable isotope ratios (an indicator of human wastewater) and male-specific coliphage (MSC, a wastewater-specific virus indicator) to determine if they were more appropriate to link elements or contaminants in shellfish to wastewater.

Results:
Wastewater contributions to shellfish growth and links to human wastewater sources were detectable using two newly coupled indicators (stable isotope ratios and MSC). Scientists found higher concentrations of bacterial and viral indicators along with lower nitrogen stable isotope ratios (indicative of wastewater contamination) at sites nearest the wastewater treatment plant. Dilution with increasing distance from the facility resulted in indicator concentrations reaching background levels at distances greater than 2 km downstream (approximately mid-bay). Based on the positive results of this research, researchers expanded and refined testing approaches to evaluate oyster suitability for human consumption. Based on this initial success, the research team has expanded its work to now include two states (Mississippi and Alabama) and are partnering with the appropriate agencies in both states. The NOAA National Science Collaborative and Sea Grant each funded an additional project to further explore this project's research results.

Recap:
Mississippi-Alabama Sea Grant-supported scientists and the U.S. Food and Drug Administration enhanced knowledge of oyster responses to nutrients and microbes in sewage-affected areas.

New filter improves water quality in recirculating marine aquaculture system, provides nutrients to enhance marsh plant growth

Relevance:
Recirculating aquaculture systems address many of the risks associated with pond or open-ocean aquaculture and provide opportunities for the development of a domestic aquaculture industry. However, the increased carrying capacity and high water quality required to make recirculating aquaculture systems competitive, as well as stringent discharge regulations, have complicated effluent management. It is therefore critical that a significant percentage of the effluent be recycled to conserve salt and reduce the discharge. To accomplish this, solids must be sequestered from the liquid and the nutrients in the liquid must be reduced before recycling back into the production system.

Response:
In partnership with Aquaculture Systems Technology, LLC, Mississippi-Alabama Sea Grant-supported scientists designed and installed a two-stage treatment system that incorporates geotextile bags to dewater the solid wastes and uses a series of mechanical and biological processes to remove excess nutrients, such as phosphorus and nitrates, so that the water can be recycled and effluent minimized.

Results:
Recirculation marine aquaculture systems removed nutrients from water. Solids collected from the geobags increased several indicators of growth in two species of marsh plants compared to the control. Some plant species adapted better to the high salinity than others, indicating the need for acclimation to maximize nutrient removal. At least one recirculating aquaculture design consulting firm includes the results of this work in their system designs.

Recap:
An engineered approach to treating marine recirculating aquaculture systems effluent successfully sequesters solids and promotes reuse of the water, and solid and liquid effluent from marine recirculating aquaculture systems serve as an adequate nutrient source for common marsh plants.

Research identifies potential management practices that enhance appearance, value of farmed oysters

Relevance:
Oyster farming is a new and promising industry on the Gulf Coast. Mud blister worms bore into oyster shells, creating bore holes that fill with anoxic sediment that can break open when oysters are shucked. This reduces the quality, and consequently the potential value, of oysters.

Response:
A Mississippi-Alabama Sea Grant Consortium-supported research project determined the factors that contribute to infestation and informs farmers of when to implement potentially costly treatment, both seasonally and in response to environmental variables. Researchers examine the impact of variables that farmers can control: stocking density, ploidy, and management techniques.

Results:
Worm infestation rates vary seasonally and among farms, but do not seem to depend strongly on stocking density or ploidy of oysters. Infestation was highest in spring and summer, but had variability across farms. Worm infestation was only weakly correlated with blister coverage. Diploid oysters had more blisters than triploids, suggesting that faster-growing triploids may recover better than diploids. Additionally, frequently desiccating oysters weekly instead of biweekly decreased the number of worms. These research findings are being incorporated into outreach products to help oyster farmers improve their farm management practices.

Recap:
Mississippi-Alabama Sea Grant-supported research identifies some benefit of using triploid oysters and supports desiccating oysters weekly instead of biweekly in the summer months to reduce worm infestation and improve farmed oyster values.

Scientists tag Atlantic tarpon, document cross-shelf migrations from Alabama waters for first time

Relevance:
Atlantic tarpon (*Megalops atlanticus*) are a highly migratory and highly prized sport fish throughout the Gulf of Mexico, including Alabama. Atlantic tarpon make extensive seasonal and regional migrations along the Gulf as part of their complex life history. Tarpon movements and habitats in the northern Gulf are largely unknown. Given these gaps, there is a clear need to investigate the movement patterns and habitat utilization of this fish.

Response:
Through funding from the Mississippi-Alabama Sea Grant Consortium and the Coastal Conservation Association of Alabama, and in collaboration with Alabama recreational fishermen, scientists deployed five satellite tags on adult Atlantic tarpon in Alabama's coastal and estuarine waters to track the large-scale movements of this fish.

Results:
Adult tarpon made coastal and cross-shelf migrations from Mobile Bay in Alabama to the continental shelf off Louisiana. This is the first documentation of adult tarpon movements within Alabama's coastal and estuarine waters. The excitement from this research has prompted local businesses, artists and fishermen to increase funding for and participate in expanding the scope of this research.

Recap:
Fishermen and researchers collaborated to document the first large-scale movement patterns of tarpon, a highly prized sport fish in Alabama, and increase interest and awareness of tarpon migration among private businesses and fishermen.

Research reveals invasive shrimp has low impact on commercially valuable native shrimp

Relevance:
The newly established exotic Asian tiger shrimp are extremely large compared to native shrimp species (often weighing up to 0.5 lb per shrimp) and are known to eat shrimp and other crustaceans in their native habitats in the Indo-Pacific Ocean. This has caused concern that the new invader may pose a predation risk to commercially important brown and white shrimp. However, no one has previously determined whether tiger shrimp can and/or will consume Gulf Coast shrimp species or how native shrimp will respond to newly invasive tiger shrimp.

Response:
Mississippi-Alabama Sea Grant Consortium-supported researchers partnered with local shrimpers to obtain live tiger shrimp and examined the propensity of tiger shrimp to consume adult and juvenile native brown and white shrimp in lab tank experiments. They also examined how native shrimp behaved when large tiger shrimp predators were present.

Results:
Tiger shrimp generally attempted to attack and eat native shrimp. However, tiger shrimp had a very low success rate, resulting in low overall predation rates on adult native shrimp and moderate-low predation rates on juveniles. These low predation rates indicate that tiger shrimp do not pose a significant predation threat to native shrimp. However, attempted predation by tiger shrimp often chased native shrimp out of their preferred sandy bottom habitats. Due to the results of this work, the researcher was included in a risk assessment study conducted by Oman Aquaculture Development Company.

Recap:
Research on tiger shrimp revealed the invasive species may not have a significant negative impact on two commercial shrimp populations as once feared.

Analysis finds more precise method for ageing Gulf menhaden, will save time and effort

Relevance:
State resource management agencies and the federal government (NOAA Fisheries) spend much time and effort to understand the age composition of the commercial harvest for Gulf menhaden. Approximately 20,000 fish will be collected and processed from the commercial fishery in 2018. However, fishery independent data (those data collected by state agencies using scientific sampling methods) are not used in the stock assessment of Gulf menhaden primarily because of the expense to process the fish for age composition. Thus, only the commercial harvest age composition is used. The result is that the perception of the stock's age composition is determined only from the commercial fishery. Methods to increase the efficiency and precision of age determination would reduce the amount of time staff need to spend processing data and result in more robust assessments.

Response:
Mississippi-Alabama Sea Grant-supported researchers evaluated the traditional scale method of age determination to understand bias and precision. In collaboration with NOAA partners, they compared estimates using three ageing structures (whole otoliths, sectioned and polished otoliths, and scales) from the same fish (400 replicates).

Results:
There was greater precision when using polished otoliths, and the processing time was equal to that of using traditional scales. If scientists increase the precision of age estimates using polished otoliths, they will need to analyze fewer structures, which will be more efficient and provide cost savings. As a result of this research, state agencies and industry will adopt this method for age determination. In addition, because of the success of this research and related work, the Sea Grant-supported principal investigator is facilitating a Southeast Data Assessment and Review (termed SEDAR) of the Gulf of Mexico Fisheries Management Council to begin the process of integrating this new approach into the formal stock assessments. Given the thousands of scales from the commercial fishery that are analyzed by the states' management agencies, analysis indicates that scientists can analyze around 50 percent fewer to achieve the same precision.

Recap:
Sea Grant research improves the precision and decreases costs of Gulf menhaden, the second largest fishery in the nation and the number one fishery in the Gulf of Mexico (by weight). These best management practices are being incorporated into future stock assessments.

Study uses DNA barcoding to identify lionfish prey items; results incorporated into ecosystem models

Relevance:
Red lionfish first appeared on reefs in the northern Gulf of Mexico (nGOM) in 2010. They have had significant impacts on the native reef fish fauna in other systems and may be having similar impacts in the nGOM given their high densities and rapid population growth. Previous diet analysis revealed lionfish to be generalist predators but nearly half of the fish prey in their stomachs could not be identified to species. Therefore, we applied DNA barcoding of identified fish prey found in lionfish stomach samples (n = 723) to more fully characterize their diet, thus potential impacts in the nGOM.

Response:
Will Patterson, Kristen Dahl, Alison Robertson and Alice Ortmann of the University of South Alabama and Dauphin Island Sea Lab collaborated to apply DNA barcoding to identify lionfish prey items, thus accurately characterizing lionfish diet and effects on native reef fishes in the northern Gulf of Mexico.

Results:
Previous diet analysis revealed that lionfish are generalist predators, but nearly half of the fish prey in their stomachs could not be identified to species. Through application of DNA barcoding of identified prey items, scientists discovered several snapper species in lionfish stomach samples, as well as widespread cannibalism of adults on juveniles. Results clearly demonstrate the power of DNA barcoding to fully describe a species' diet and suggest that the most likely life stage for substantial predation on lionfish themselves is the newly-settled juvenile stage. Results were incorporated into an Ecopath with Ecosim ecosystem models to examine the impacts of lionfish in the nGOM. Scientists have since applied the DNA barcoding technique to native nGOM reef fishes to examine whether they are consuming juvenile lionfish.

Recap:
DNA barcoding of unidentifiable invasive lionfish prey items incorporated into two ecosystem models.

Research increases awareness of Gulf of Mexico oyster appellations, value of farmed oysters

Relevance:
Although they are the same species (eastern oyster, *Crassostrea virginica*), oysters marketed along the Atlantic Coast sell under regional names, such as Wellfleets (from Cape Cod), Blue Points (Long Island) and Chincoteagues (Virginia). Gulf oysters are usually sold as generic oysters with the exception of Apalachicolas (Florida), which comprise the bulk of Florida's oyster harvest. Although there is no clear evidence that they sell at a premium, it is evident that a market has developed for these branded oysters. It was not known if other branded Gulf oysters could demand a premium price.

Response:
Three promotional taste panels consisting of 169 panelists were held in Houston, Point Clear, Alabama, and Chicago. Additionally, an online survey of 730 U.S. households was conducted as part of this research. Both of these have increased the awareness of a variety of Gulf oyster appellations among a targeted audience of oyster consumers at high-end restaurants and households, both inside and outside of Gulf markets. Results indicated the potential for demand for these premium oysters. An industry member reported that several restaurants in Texas and Florida have begun selling a variety of named oysters for a premium price.

Results:
Results indicate that Gulf residents are willing to pay at least some premium for branded Gulf oysters, and non-Gulf consumers are also favorable toward Gulf oysters (although there is evidence of a price discount). This project led to the Gulf Oyster Industry Council receiving external funding to market branded Gulf oysters. Additionally, results were shared with Louisiana Marine Extension leaders at the Louisiana Marine Extension Project Quarterly Meeting in Grand Isle, Louisiana, June 3, 2014; and with researchers, practitioners and government agency leaders at the 2012 Bays & Bayous Symposium, Biloxi, Mississippi, the 2014 National Shellfisheries Association Annual Meeting in Jacksonville, Florida, and at the 2013 and 2016 National Forum on Socioeconomic Research in Coastal Systems in New Orleans.

Recap:
Awareness of Gulf of Mexico oyster appellations increased as a result of Sea Grant research and industry marketing efforts.

Model incorporates Mississippi-Alabama Sea Grant research to assess genetic risks for red snapper offshore aquaculture

Relevance:
Delineation of management units for stock enhancement of marine species is currently limited because traditional methods to assess population structure cannot assess effectively local genetic adaptation. Local genetic adaptation is of primary importance when planning releases of organisms during enhancement or evaluating the potential impacts of escapes from offshore net pens.

Response:
Next generation sequencing technologies through the double digest Restriction Associated DNA-Tag sequencing (ddRAD sequencing) protocol were used to map the red snapper genome and analyze genome wide divergence of regional populations in a high-density genome scan. This new assessment of red snapper population structure in U.S. waters included variation at neutral Single Nucleotide Polymorphism (SNP) loci but also at possible SNPs under selection identified during outlier analyses.

Results:
A high-density linkage map was developed based on five red snapper full-sib families and used to map and orient genome contigs. Analysis of four populations off the U.S. East Coast and the eastern, north-central and western Gulf of Mexico revealed weak divergence among regions and only weakly divergent outlier SNPs. A panel of neutral SNPs suitable for genetic tagging and monitoring of genetic diversity during stock enhancement was designed and used to monitor releases in Mississippi. Sea Grant-supported scientists shared the findings on population structure with NOAA scientists, and they are used in formulating scenarios in the Offshore Mariculture Escapes Genetics Assessment (OMEGA) model to evaluate genetic risks of red snapper offshore aquaculture projects.

Training program teaches potential Mississippi oyster farmers basics of off-bottom oyster aquaculture

Relevance:
In response to poor oyster harvests, the Mississippi Governor's oyster recovery plan includes investment in off-bottom oyster aquaculture. Residents interested in becoming oyster farmers requested assistance with permitting and guidance on oyster farming techniques.

Response:
In 2017, four Mississippi residents took part in a formal adult training program, Oyster Farming Fundamentals, through a Sea Grant-supported program. During a five-session, 15-hour course, participants received basic training on oyster farming techniques and methods, marketing, harvesting and permitting requirements. The course also included hands-on training in starting and operating a commercial oyster farm.

Results:
The four participants in the oyster farming training have expressed interest in pursuing commercial off-bottom oyster farms. One person has purchased over 200,000 oyster seed in anticipation of newly permitted areas in Mississippi.

Recap:
A Mississippi-Alabama Sea Grant-supported program offered a training program in Mississippi to four potential oyster farmers who received enough hands-on training to start and operate a commercial oyster farm.

Comments:
Mississippi Department of Marine Resources

Goals:
A future workforce reflecting the diversity of Sea Grant programs, skilled in science, technology, engineering, mathematics and other disciplines critical to local, regional and national needs.
A safe, secure and sustainable supply of seafood to meet public demand.

Symposia increase beginning oyster farmers' knowledge, industry resilience

Relevance:
Within the last 5-8 years, a number of commercial off-bottom oyster farms have been established in Louisiana, Alabama, Florida, South Carolina and North Carolina, with significant interest in Mississippi, Georgia and Texas. Though newly established and relatively small-scale, these oyster farms have formed an off-bottom oyster farming industry in the southern region. There is an opportunity to improve the resiliency of these new oyster aquaculture businesses through regional training and outreach including business planning and best management practices.

Response:
A Mississippi-Alabama Sea Grant-funded project (through the Sea Grant National Aquaculture Initiative) provided scholarships to over 120 commercial oyster farmers to attend the first two annual Oyster South Symposia. The symposia included a variety of talks, demonstrations and trade shows. At least 285 people, including current and potential oyster farmers, wholesalers, gear suppliers, restaurant industry members, researchers and Extension and Sea Grant specialists have attended the symposia. In addition to formal talks (given by growers, Sea Grant specialists, researchers, chefs and marketing experts), growers were able to attend mixers with chefs and other culinary professionals, as well as an oyster tasting where Southern oysters were featured (at the Fourth and Fifth Alabama Oyster Social), which greatly enhanced learning and networking opportunities for the attending commercial oyster farmers.

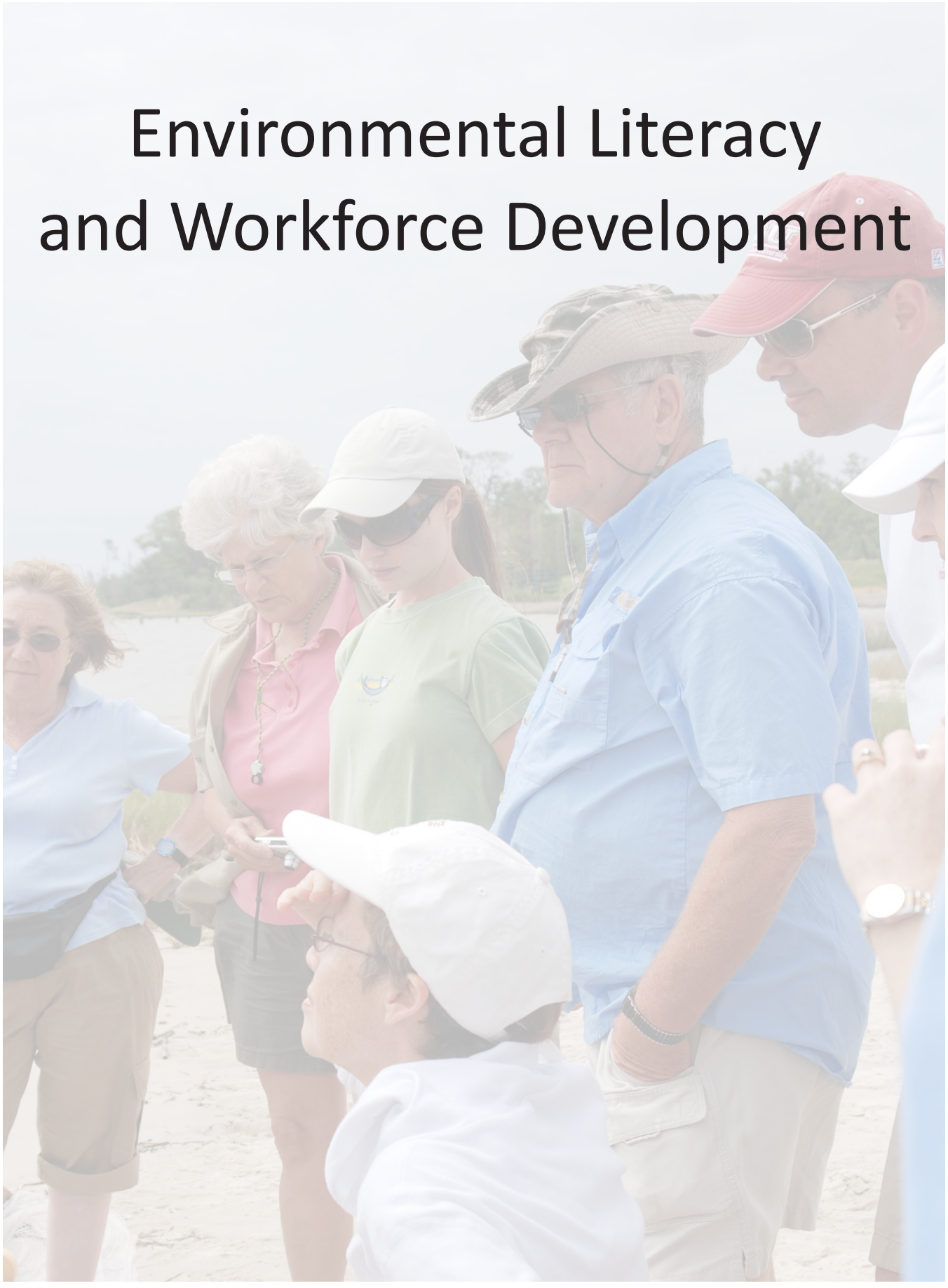
Results:
Notably, statistically significant increases in knowledge (ANOVA, $p < 0.05$) were recorded for each symposium (based on pre- and post-self-assessments at the symposia), including the topics of:

1. Off-bottom techniques and culture methods used to raise oysters +25-26% (depending on year)
2. Assuring oysters are safe for consumption +12-30%
3. Disaster preparation and recovery +53-61%
4. Branding and marketing +46%.

Post-workshop surveys after the first symposium in Alabama indicated that commercial growers wanted an annual symposium to provide additional learning opportunities. Additionally, there were requests to rotate the venue to allow easier attendance for growers from different states, as well as requests for field trips to oyster farms or related businesses and other opportunities for growers to learn from other growers, with a clear desire for expanded possibilities for peer-to-peer learning. In response to the feedback from the first annual symposium, the 2017 Oyster South Symposium was held in South Carolina, and plans are underway for the 2019 symposium to be held on the northern Gulf Coast. Based on in-person interviews, at least 30 industry members have adopted practices or techniques learned at these symposia.

Recap:
The Oyster South Symposium was created to provide a forum for the oyster farming industry to learn the most current information needed to be successful.

Environmental Literacy and Workforce Development



More than 550,000 Gulf citizens increase understanding of local, regional environmental issues through free-choice learning

Relevance:
Exhibits and outreach events offer engaging ways to deliver ocean science content. They can also highlight Sea Grant research findings and increase the public's understanding of important coastal issues. People are more likely to be good stewards of the natural environment if they understand why it is valuable. Voluntary attendance at aquariums, nature centers, environmentally themed festivals and informal lectures indicate a desire to engage in free-choice learning.

Response:
The Mississippi-Alabama Sea Grant Consortium supported educators who participated in regional environmental festivals, exhibitry and programs at Mobile County Public Schools' Environmental Studies Center, The University of Southern Mississippi Gulf Coast Research Lab's Marine Education Center and The Estuarium (Dauphin Island Sea Lab's public aquarium). The educators provided visitors with credible, specific and relevant information on a variety of coastal topics.

Results:
During 2014-2017, educators engaged with more than 550,000 people through the three learning centers and more than 300 outreach events. Outreach activities included annual events, such as Celebrate the Gulf, Delta Woods and Waters, Earth Day(s), BirdFest, ShrimpFest, Peter Anderson Festival, boat shows and open houses. Other structured events included Science Cafes, Catch more Fish with Science seminars and Boardwalk Talks. Conversations and anecdotal comments indicated that visitors valued seeing coastal ecosystems and learning about coastal issues.

Recap:
During the period 2014-2017, educators used exhibitry, environmentally themed events, public lectures and other activities to expose more than 550,000 people to ecosystems, environmental issues and the impacts of human activities.

High-profile regional, national competitions expand students' knowledge of oceans, increase career awareness

Relevance:
Extracurricular activities, such as science fairs and other student-focused competitions, help students learn and develop skills beyond what they learn in classrooms or in the field. In these competitions, students experience a deeper level of engagement in practicing science. They also increase their awareness of career opportunities.

Response:
During 2014-2017, the three Mississippi-Alabama Sea Grant-supported environmental learning centers in Mississippi and Alabama hosted science fairs, regional and national Ocean Bowl events, and annual regional MATE ROV (remotely operated vehicle) competitions. Sea Grant-supported educators at the Mobile County Public School System's Environmental Studies Center (ESC) organized and hosted the district science fair for middle- school and high-school students. Educators from the ESC and Dauphin Island Sea Lab's the Discovery Hall Programs (DHP) served as judges for school-based, regional and state science fairs in Alabama. At the University of Southern Mississippi Gulf Coast Research Lab's Marine Education Center (MEC), Sea Grant-supported educators organized and hosted the Hurricane Bowl, a regional competition of the national Ocean Sciences Bowl. In 2015, the MEC also hosted the 18th Annual National Ocean Sciences Bowl. MASGC-supported educators at DHP organized and hosted the annual Northern Gulf Coast regional competition of the international ROV competition.

Results:
Sea Grant-supported educators offered extracurricular activities that reached approximately 750 middle- and high-school students through science fairs and academic and skill-based competitions. The competitions also involved approximately 500 volunteers, teachers and other educational professionals. Annual evaluations of the Ocean Bowl and the ROV competition demonstrated increased knowledge, enhanced development of STEM and 21st Century skills, and increased career awareness.

Recap:
Sea Grant-supported educators at three learning sites hosted student-focused competitions that reached approximately 750 students and 500 teachers and adult volunteers. The competitions increased environmental literacy, enhanced STEM and 21st Century skills, and heightened career awareness.

Cross-cutting

Scientists, professionals exchange information at regional coastal symposium

Relevance:
Through conversations with stakeholders, the Mississippi-Alabama Sea Grant Consortium (MASGC) identified that local professionals in the tourism, habitat management and education industries were lacking local/regional science information. While many scientists focus on presenting their research at national conferences, Mississippi-Alabama Sea Grant's constituents were interested in science information that affected them at the local level. They also preferred a forum that was close to home and did not require days of travel.

Response:
MASGC works with the Mobile Bay National Estuary Program and other partners to organize the Mississippi-Alabama Bays and Bayous Symposium every two years. Every fourth year (2016, for example), MASGC leads planning efforts and performs most all planning and coordination tasks. In other years, MASGC plays a strong supporting role. Sessions at the symposia focus on the northern Gulf of Mexico with topic areas, such as habitat management and restoration; living estuarine resources; water supply and quality; and natural hazards resilience.

Results:
In 2014 and 2016 combined, 670 professionals and students attended the Bays and Bayous Symposium to learn about current research and other science-related information about the Northern Gulf of Mexico. More than 360 presenters shared their research and projects over the two-day events. The symposia also allowed attendees to network with professionals, students and residents interested in coastal sciences.

Recap:
The 2014 and 2016 Mississippi-Alabama Bays and Bayous Symposia allowed 670 scientists, professionals and students to network with others and learn about local, relevant coastal research in the northern Gulf of Mexico.

Communications improves MASGC documents, submits publications to library

Relevance:
Mississippi-Alabama Sea Grant Consortium team members produce communications products, such as fact sheets, journal articles and e-newsletters, to inform stakeholders about research results, best practices and programs. Team members often need editing assistance to make their publications as useful as possible. The National Sea Grant Library also requires that these tools are submitted to its comprehensive library collection for public access.

Response:
In 2014-17, the Mississippi-Alabama Sea Grant communications department edited more than 400 documents for content, design, grammar and copyright issues. The department also cataloged 328 publications in its system and submitted those publications to the National Sea Grant Library.

Results:
The communications department improved the quality of more than 400 documents. The department also submitted 328 publications to the National Sea Grant Library, meeting reporting requirements and making the publications publicly accessible.

Recap:
Mississippi-Alabama Sea Grant's communications department edited more than 400 documents and submitted 328 publications to the National Sea Grant Library.

Educational TV messages teach large numbers of coastal residents best stewardship practices

Relevance:
The Mississippi-Alabama Sea Grant Consortium works to improve environmental and economic health of its communities. To do this, it must make residents and leaders aware of issues along the Gulf Coast and actions that may lead to resilient communities and enhanced conservation of our natural resources.

Response:
Mississippi-Alabama Sea Grant contracted with Gary Finch Outdoors (a 30-minute TV outdoors program that has aired for years on the Alabama coast and the Florida panhandle) and produced informational videos to air during the outdoors show on WSRE-TV, a public television station in Pensacola, Florida. The videos were 2 minutes and 21 seconds long and explained over a dozen different Gulf Coast issues or resources to a residential audience. Topics included clean marinas, oyster gardening, the Magnuson-Stevens Act and more.

Results:
Each of the 33 videos aired twice a week for one or more weeks on WSRE-TV (PBS, Pensacola, Fla.) in late 2012 and in 2013. Each Gary Finch Outdoors show reaches more than 480,000 households. Nine 2-minute videos on the subjects also were created and aired on Channel 3 WEAR-TV (ABC, Mobile, Ala.) during the 6 a.m. newscast, which reaches 531,000 households. The videos also were posted on the Mississippi-Alabama Sea Grant YouTube Channel (https://www.youtube.com/user/MSALSeaGrant) and received 38,641 views through May 2018.

Recap:
The Mississippi-Alabama Sea Grant Consortium created short videos about coastal issues, which potentially reached hundreds of thousands of residents during a popular outdoors show on a PBS TV station in Pensacola, Florida, a morning TV news station in Mobile, Alabama, and Mississippi-Alabama Sea Grant's YouTube channel.

Outreach, education teams publish 10 newsletters, inform more than 10,000 readers about Sea Grant programming

Relevance:
The Mississippi-Alabama Sea Grant Consortium has extension, outreach and education specialists who develop, coordinate and facilitate multiple programs. Many people want to stay informed about these programs. Newsletters sent through the mail, e-mail, posted online or shared through social media are a useful tactic in disseminating program information to participants and others interested in Sea Grant work.

Response:
Mississippi-Alabama Sea Grant team members published 10 different topical newsletters or e-newsletters on marine fisheries, oyster gardening, legal research, resilience tools, wildlife, local food, sea-level rise, Mississippi-Alabama Sea Grant-sponsored research and more. The frequency of the newsletters varied from three issues a year to 20 issues a year.

Results:
In 2014-17, Mississippi-Alabama Sea Grant team members published 216 issues of 10 newsletters and distributed 43,078 copies of them through various channels, including mail, e-mail, websites and social media. The newsletters provided program and educational information to more than 10,000 recipients.

Recap:
Mississippi-Alabama Sea Grant outreach and education team reaches more than 10,000 people through 10 topical newsletters.

Outreach, education specialists reach thousands of constituents through staff blog

Relevance:
Mississippi-Alabama Sea Grant communications consistently works to increase visibility of its work and program. With a small department, it is challenging to know everything that team members are doing in their communities and to share that information with a broader audience. The program's outreach and education teams have goals of sharing current research, data and developments with stakeholders in its diverse areas of expertise.

Response: From 2015-2017, Mississippi-Alabama Sea Grant educators and outreach team members wrote 134 weekly staff blogs (http://masgc.org/news/category/blog) on topics related to healthy coastal ecosystems, sustainable fisheries and aquaculture, resilient economies and communities, and coastal stewardship and workforce development. To increase visibility of the Sea Grant program's work, the blogs highlighted research, coastal issues, Sea Grant events, fellowship opportunities, legal research, marine economics and education programs. Mississippi-Alabama Sea Grant communications also shared the blogs on the program's Facebook and Twitter accounts and highlighted them in the program's e-newsletter.

Results:
Mississippi-Alabama Sea Grant staff blogs garnered 9,664 page views in 2015-17, according to Google Analytics (which may not include visitors who have installed ad blockers on their Internet browsers). Followers on Facebook engaged with posts about the blog more than 2,425 times and clicked on blog links more than 3,280 times. On Twitter, followers engaged with tweets about the staff blog more than 1,430 times.

Recap:
The Mississippi-Alabama Sea Grant Consortium's outreach, education staff connected with thousands of constituents through its weekly blog.

Mississippi-Alabama Sea Grant social media efforts increase stakeholder engagement

Relevance:
According to a 2018 Pew Research Center survey, 68 percent of U.S. adults use Facebook and 24 percent use Twitter. (http://assets.pewresearch.org/wp-content/uploads/sites/14/2018/03/01105133/PI_2018.03.01_Social-Media_FINAL.pdf). These social media platforms are valuable tools in communicating with stakeholders and potential stakeholders outside of other outreach methods.

Response:
The Mississippi-Alabama Sea Grant Consortium's communications coordinator regularly posts on the program's Facebook and Twitter accounts to share research, outreach events and other information and engage with constituents.

Results:
From 2014-2018, Mississippi-Alabama Sea Grant added 1,187 followers to its Facebook and Twitter platforms. Followers engaged with MASGC social media content 42,148 times. MASGC social media posts and tweets reached social media feeds 561,946 times.

Recap:
Mississippi-Alabama Sea Grant communications engaged constituents and raised awareness of Sea Grant programs and efforts through social media platforms.

Gulf Sea Grant Programs build program that shares oil spill science with thousands

Relevance:
In 2010, approximately 172 million gallons of oil and more than 1.84 million gallons of dispersants entered the Gulf of Mexico. Eight years after the Deepwater Horizon oil spill, questions linger about the impacts of oil and dispersant on animals, ecosystems, coastal communities and human health. Questions also emerge related to preparation for future large-scale events.

Response:
The four Gulf Sea Grant programs received funding from the Gulf of Mexico Initiative to develop an oil spill science outreach program in 2014. The program is made up of a six-member, multidisciplinary team of extension and communications professionals located around the Gulf and shares science with specific target audiences that include fishers, coastal tourism professionals, oil spill response personnel, university researchers and other Sea Grant agents around the country.

Results:
In fewer than four years, the outreach team collected input from more than 1,100 target audience members; organized 23 science seminars with 148 presenters and 1,910 attendees; delivered 140 presentations to 5,318 people; produced 21 extension publications; built a science-sharing network of more than 2,443 people; and designed a website that has attracted 22,645 unique visitors and 52,626 views. Through this program, the team has answered many questions from audiences in the Gulf and around the country. The program is a model for successful inter-program collaboration to address a need. Due to the project's success, the Gulf of Mexico Research Initiative extended the Sea Grant oil spill outreach program's funding.

Recap:
The Gulf of Mexico Sea Grant programs implemented a regional oil spill science outreach program, delivered science extension products (based on audience needs) to thousands of people throughout the nation and earned a funding extension.

Goals:
An environmentally literate public supported and informed by a continuum of lifelong formal and informal engagement opportunities.

Sea Grant oil spill science outreach program expands to reach audiences nationwide

Relevance:
While sharing oil spill science with target audiences in the Gulf of Mexico, the oil spill science outreach program observed the need to share similar information with other Sea Grant programs and organizations elsewhere in the U.S. and internationally. Oil spills are not unique to the Gulf of Mexico. As federal laws regarding oil exploration change, audiences beyond the Gulf show interest in oil spill science, particularly preparing for and responding to future events.

Response:
The oil spill science outreach team collaborated with Sea Grant programs around the country to develop tailored workshops in three other regions of the United States in 2017 and 2018. Additionally, the National Academy of Sciences approached the Sea Grant oil spill team to collaborate on a national effort to improve the quality, accessibility and use of information related to protecting communities from oil spill impacts. The Sea Grant oil spill science outreach program has connected federal, regional, Sea Grant and state partners with each other and with others in need of oil spill science expertise.

Results:
Due to engagement with the Sea Grant oil spill science outreach team, the Sea Grant programs across the country are learning about oil spill science and response and connecting with groups, such as the U.S. Coast Guard and NOAA's Office of Response and Restoration. Invited presentations at regional, national and international conferences allow the program to reach target audiences more broadly than previously possible.

Recap:
While continuing to serve target audiences in its home region, the Gulf of Mexico Sea Grant oil spill science outreach program expands its reach nationally and internationally by partnering and sharing with a variety of organizations.

Team creates a library of oil spill science outreach publications for audiences in and beyond Gulf region

Relevance:
Diverse audiences that Sea Grant serves continue to have lingering questions about the Deepwater Horizon oil spill's impact on wildlife, ecosystems, coastal communities and human health.

Response:
In 2014, the Gulf of Mexico Initiative funded Sea Grant to develop an oil spill science outreach team made up of six extension and communications professionals located around the Gulf of Mexico. The program shares peer-reviewed science regarding oil spill impacts with target audiences in the Gulf and around the country who depend on healthy marine ecosystems for work or recreation. Team members synthesize available science to answer audiences' specific questions in one-page fact sheets and longer outreach publications.

Results:
The team has produced 21 extension publications, available in print and online. The team's award-winning publications focus on topics that range from oil spill response methods to human, wildlife and habitat impacts. Many contain graphics specially designed to explain scientific processes—simple, clear figures that audiences have asked to share in their own publications and presentations. A fact sheet for boaters on handling oil spills has been translated into Spanish and Vietnamese, adapted for use by two other Sea Grant programs outside of the Gulf and distributed widely by target audiences, such as the oil industry and U.S. Coast Guard.

Recap:
In fewer than four years, a regional oil spill science outreach program created and delivered a diverse library of 21 extension publication to answer agency and industry questions.

Communications support expands Gulf-wide oil spill science outreach program offerings

Relevance:
After 2010's Deepwater Horizon oil spill, regional audiences who rely on a healthy Gulf of Mexico for work or recreation had questions about its impacts but might not be able to access or understand published science on the subject. In 2014, Gulf Sea Grant programs formed a regional team to produce a variety of products to address audience concerns.

Response:
In late 2016, the Sea Grant Oil Spill Science Outreach Team restructured its approach to program level communications and added a dedicated communicator, based at the Mississippi-Alabama Sea Grant Consortium, to the team.

Results:
The new approach and changes streamlined the process for producing outreach tools and expanded the team's reach in print, online and at seminars around the country. During the 2017 reporting period, the team released 10 new publications (bringing its total to 21) and translated one popular fact sheet into Spanish and Vietnamese. The Mississippi-Alabama Sea Grant-based communicator provided webinar support at six oil spill science seminars and led the redesign of the Gulf of Mexico Sea Grant regional website (http://gulfseagrant.org) to showcase all program publications and feature 79 embedded videos of seminar speakers, edited to include speakers' slides. The website reported 16,886 views during the reporting year.

Recap:
Mississippi-Alabama Sea Grant Consortium's communications support to the Gulf-wide oil spill science outreach program enabled the team to improve efficiency and consistently produce a variety of outreach products to address audience needs.

Mississippi-Alabama Sea Grant Consortium's oil spill science outreach professionals synthesize, deliver science to audiences in Gulf and beyond

Relevance:
In 2014, the four Gulf of Mexico Sea Grant programs formed a regional team to produce a variety of products to address audience concerns about lingering impacts from 2010's Deepwater Horizon oil spill.

Response:
Oil spill science outreach team members from the Mississippi-Alabama Sea Grant Consortium worked directly with target audiences to answer their questions in print, in person and online both in the Gulf region and around the country. These questions related to oil spill impacts, preparedness and response.

Results:
Mississippi-Alabama Sea Grant team members coordinated the overall team activities and supported communications-related activities. In 2017, Mississippi-Alabama Sea Grant staff produced an outreach bulletin and four one-page fact sheets answering oil spill science questions. The oil spill science outreach professionals gave presentations to people in the Gulf region and throughout the country. They also led or supported six live-streamed seminars that reached approximately 200 people. The regional website (gulfseagrant.org), updated and reorganized at Mississippi-Alabama Sea Grant, includes the team publications and other outreach materials, including 79 video clips from seminars.

Recap:
Mississippi-Alabama Sea Grant-based members of the Sea Grant Oil Spill Science Outreach Team led the team and supported its communications needs through numerous methods, including various types of publications, seminars and webinars, while working with audiences in the Gulf and around the country.

K-12 aquascience training enhances math and science classroom experiences for teachers, students

Relevance:
Hands-on math and science tools are used to engage and maintain student interests in core math and science classes.

Response:
An extension specialist implemented a combination of week-long intensive workshops and one-on-one site visits with teachers throughout coastal Alabama to provide teachers with the necessary tools to integrate K-12 aquaculture/aquascience/aquaponic components into their existing curricula.

Results:
Between 2010 and 2017, 176 teachers from school systems throughout Alabama, across the United States and several international locations (Africa, India, etc.) participated in week-long summer workshops, which were supported by Sea Grant. These events focused on applicable and practical mathematics (volumetric and mass based enumeration, feed conversion ratio, planting and stocking densities), in connection with state accepted course of studies, development of lesson plans, biological and environmental concepts (nitrogen cycle), fish health (bacterial, viral, parasitic investigations), water quality (hands-on testing and interpretation), anatomy and system function (dissection and spawning), real-world practice in working hatcheries to prepare them for their own systems, and hands-on system construction for program development and expansion. Because the average teacher from the workshop teaches 25 students per class and has six classes per year, between 2010 and 2017, approximately 120,000 students benefited from the hands-on activities intrinsic to the K-12 science and mathematics programs shared at the Sea Grant-sponsored workshops.

Recap:
Students and teachers integrated learning opportunities into existing science and math curriculum through Sea Grant-supported workshops, and site visits focused on hands-on aquascience activities in the classroom.

MASGP-18-039 This publication was supported by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration under NOAA Award NA14OAR4170098 and the Mississippi-Alabama Sea Grant Consortium. The views expressed herein do not necessari-ly reflect the views of any of these organizations.