

— *the Governor's* —
Oyster Council



RESTORATION & RESILIENCY

FINAL REPORT

JUNE 2015





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Chapter 1

Foreword by Governor Phil Bryant

Dear Chairman Dennis,

On February 2, 2015, I issued Executive Order 1350, creating the Governor's Oyster Restoration and Resiliency Council. The Oyster Council's purpose is to discuss and analyze environmental and economic factors and influences on the oyster resource while exploring the role aquaculture and emerging technologies will play in growing the industry. Upon analysis of the factors and influences, the Oyster Council was charged with generating a Report that captures, develops and organizes recommendations, projects and programs for the restoration and resiliency of the oyster resource and industry.

The Oyster Council met its purpose and this Report exceeded my expectations. I'm very grateful to everyone who put their time, energy and efforts into this Report as the State will utilize it as foundation upon which policies will be built to guide the Oyster Industry into the future. I recognize it will take the coordination of several state and federal agencies and institutions to implement successfully the programs and projects described in the Report. To that end, I pledge my full support in seeking cooperation from all entities concerned.

Mississippi has a long history of supporting our farmers, and the State continues to put significant effort into agricultural research, development and funding. If someone wants to grow soybeans, the State does all that it can do to help. We need to do the same for oysters, which have the potential to become the "soybeans of the sea." This Report describes and demonstrates the need for Mississippi to increase its focus and support of our Oyster Industry.

Thank you Chairman, the Committee Chairs, Director Miller and all of the members of the Oyster Council who took the time and made the effort to develop this Report. You have my full attention and support as your efforts continue into the future.



Sincerely,

Phil Bryant
Governor
State of Mississippi



The background of the page is a photograph of a beach and ocean. The foreground shows the sandy beach with some small rocks and debris. The ocean is in the middle ground, with gentle waves. The sky is in the background, with some clouds. The overall color palette is muted, with a lot of beige, tan, and light blue tones.

Chapter 2

Overview and Summary of Recommendations

What

The Governor's Oyster Restoration and Resiliency Council ("the Oyster Council") created on February 2, 2015 by Executive Order 1350 by Governor Phil Bryant.

Who's on It

Citizens, scientists, oystermen, and seafood industry leaders representing a broad cross-section of interests and disciplines.



The Mandate

Through intensive collaboration with individuals and organizations that work in or are impacted by the Oyster Industry, the Oyster Council will

- Develop a comprehensive Oyster Resource Resiliency Report ("Report") recommending actions and management strategies based on best practices in the Oyster Industry and regulatory framework.
 - » Outline resiliency strategies to respond not only to disasters such as the Bonnet Carré Spillway Opening or the BP Oil Spill but also to other forces, including hurricanes and sudden shifts in economic and environmental conditions.
 - » Address environmental and economic factors and influences as well as aquaculture and emerging technologies.
- Propose any regulatory or statutory revisions necessary or advisable in order to implement actions contained in the Report.
- Propose one or more projects and programs,

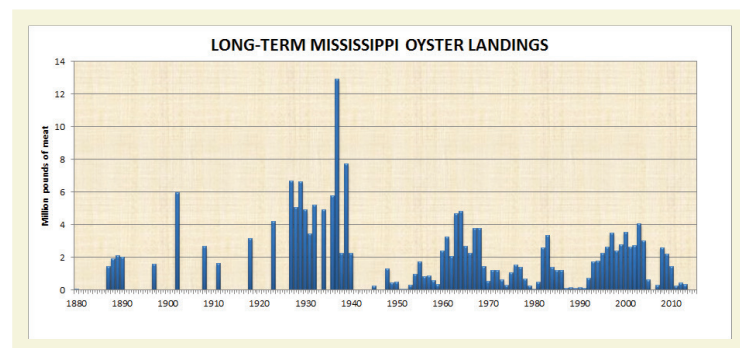
including aquaculture (pilot or ongoing), with sufficient information and clarity to be implemented as part of initial actions to be taken in accordance with those recommended in the Report.

The Deliverable

A written Oyster Restoration and Resiliency Report incorporating all mandates of the Oyster Council, which will be accessible to policy makers, the Oyster Industry and citizens.

Where We Are

The 2014-2015 season was another low producing oyster season in Mississippi and throughout the Gulf. Ten years ago (in 2004), over 400,000 sacks of oysters were harvested from Mississippi waters. Since then, the resource has endured Hurricane Katrina, the BP Oil Spill, and the Bonnet Carré Spillway opening. In the 2013–2014 season, oystermen harvested about 70,000 sacks of oysters. The 2014–2015 season, as predicted, was an even slower year, with production of 26,000 sacks. The reefs were very stressed at best; in fact, industry representatives and Mississippi Department of Marine Resources ("MDMR") biologists debated if Mississippi should open the past season at all.



Source: MSU Ext. Center

Where We Want to Be

In spite of the low production in the 2014-2015 oyster season, Mississippi is positioned to become a Gulf of Mexico leader in oyster production and desires to reclaim its place as the "Seafood Capital

of the World.” From its inception, the Oyster Council established as its goal for Mississippi to produce One Million sacks of oysters a year by 2025. To get there, the State must develop a Report that incorporates current best practices and technologies for production, management, and conservation, then implement it and have the united will to stick to it.



How We Get from Where We Are to Where We Want to Be

The Oyster Council applauds the Governor for recognizing the plight of the Oyster Industry, for drawing attention to it, and for having the vision to do something about it. This Report must be the beginning of a long-term oyster resource management plan and program. The Report should guide State and Federal leaders in implementing policies to increase, enhance and promote the Oyster Resource, boosting the importance of the Gulf Coast not only to Mississippians, but to the Gulf region and the nation as a whole.

The recommendations developed by the Oyster Council must have the commitment of State and Federal policy makers to make the difficult decisions necessary to grow the oyster resource. The public also must be encouraged to give input and participate in the process.

The Role of the Oyster Council

The charge to the Council was to develop a Report for Oyster Resource creation and management, in accordance with the mandates set forth. In collaboration with individuals and organizations across the full range of subject areas, the Oyster Council worked to broaden the community's understanding of how to enhance oyster habitat and increase oyster production. At the same time through a series of public meetings across the Coast, the Oyster Council encouraged participation and gathered public input.

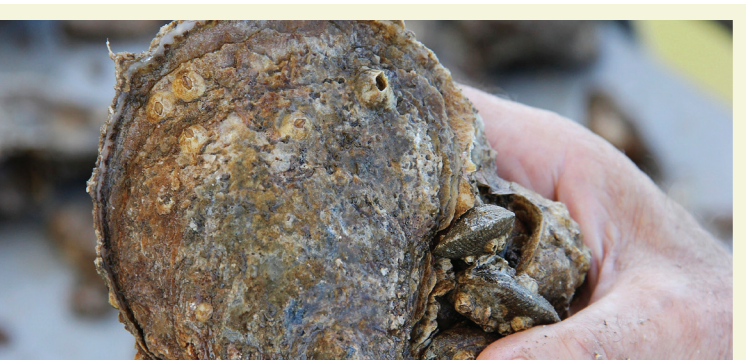
The Oyster Council is comprised of representatives from the following groups or organizations: tongers, dredgers, processors, State government, Federal government, restaurant/hospitality, finance, marketing, research, non-profit, and environmental. Members of the Oyster Council served without compensation.

The Oyster Council explored and evaluated best practices and programs adopted by Mississippi, our neighbor states in the Gulf, and other major oyster harvesting communities around the country in order to develop a bold, implementable Report to grow Mississippi's oyster population.

The Oyster Council is comprised of three committees: Oysters in the Economy, Oysters in the Environment, and Aquaculture and Emerging Technologies. Each committee had clear, defined but separate scopes, and each operated independently. To prevent duplication of effort, the Oyster Council met often, resulting in cross-pollination of ideas and integrated recommendations.

What Does Success Look Like?

The State will reach the goals of increasing oyster harvest and creating new job and business opportunities while improving the environment through species recovery, habitat creation, and improved water quality.



New Organizations, Approaches and Tools Necessary to Implement the Oyster Council's Report

- Form Oyster Recovery Partnership (“ORP”) – Private sector NGO/non-profit to serve as communication platform and coordinating entity for implementation of the projects and programs recommended in this Report.
- Convert Oyster Council Executive Committee to an official advisory role.
- Anticipate, propose, and guide to adoption future legislative and regulatory adjustments to enhance the ongoing success of the Oyster Industry.
- Designate an Oyster Extension Agent (“OEA”) within MDMR to facilitate and coordinate aquaculture and private leasing requirements, processes, and activities.
- Develop a management plan and strategy based on the implementable recommendations contained in this Report.
- Link historic oyster bed areas to specific threats.
- Develop, fund, and implement a comprehensive habitat and bottom mapping plan, which takes a stepwise approach starting with Western Mississippi Sound and includes routine mapping, sediment sampling, and analysis of rates of deposition and erosion.
- Continue to sample annually with a focus on developing a stock assessment or model that can be utilized for sustainable harvest.
- Identify and model hydrological and salinity regimes.
- Prevent conflicts of use through Suitability Mapping to layer in and identify stakeholders who use the bottoms.
- Adopt hazard mitigation plans and pollution prevention plans to focus on protection of natural resources (oyster beds) in the event of storms.
- Promote living shorelines and green infrastructure.
- Promote shell recycling program and incentive program to processors.
- Increase public education and outreach regarding the value Oyster Resources beyond the fishery with translators at meetings.
- Increase stakeholder engagement and outreach.
- Consider including commercial oystermen for research, cultivation, relays and other activities described in the Report, when economically and functionally feasible.

How Do We Position Ourselves for Success?

This Report was not developed just to sit on a shelf. The State should vet, confirm, and implement the findings of merit and realistic recommendations contained in the Report. To do this, the State should allow for funding to be allocated toward the implementation of priority projects or programs recommended by the Oyster Council.

What Are the Oyster Council's Ideas, Thoughts and Recommendations?

The results of the Oyster Council's work follow, starting with a summary of recommendations. Each Committee's chapter then provides the specifics on the topics it investigated and the recommendations based on its scope. Upon review of each Committee's chapter, the Executive Committee of the Oyster Council proposes the following recommendations for action by the appropriate agencies, legislative bodies, and other institutions.

The recommendations are organized by topic, and prioritized within each topic. For additional information about a recommendation below, see the specific Committee and subcommittee chapters of this Report.





Improve Water Quality and Quantity

- Continue to focus on barrier island restoration and coastal marsh restoration.
- Focus land acquisition, conservation, and restoration efforts in historical oyster-producing watersheds.
- Commission a regional, integrated watershed management plan.
- Expand Coastal Stream Assessment Project to all coastal streams within five years.
- Develop a specific plan to remove storm water drains from beach areas.
- Play detective for each water body – use “fingerprinting” to identify contaminants.
- Target at-risk areas and areas for potential for harvesting and employ location-specific remedies to address identified water quality concerns.
- Educate decision-makers on impacts of major freshwater-depleting projects.
- Implement aggressive storm water management, starting near oyster habitat.
- Identify and repair impaired wastewater infrastructure nearest oyster habitat.



Enhance Public Reefs

- Identify threats to oyster survival for each historic area individually – Biloxi Bay, Graveline Bayou,

Mouth of Pascagoula River, and Pass Christian.

- Harvesting Practices
 - » Adopt management practices and metrics to assess health of reefs and to determine harvest capacity, by way of sacks, not days.
 - ◊ Establish quotas, similar to those imposed on other species.
 - ◊ Close season for areas once established quota is reached.
 - » Open and close specific reef areas based on projections that leave sufficient biomass for a sustainable or increasing fishery in the following year.
 - » Allow for higher sack-per-day limit, up to 50 sacks per day, to be determined by sampling.
 - » Consider adjusting the Tong Line to comport with reef conditions.
 - » Consider an increase in license fees (by double) for out-of-state licenses.
 - » Consider adoption of a Shell Budget Model or other no-net change based model to manage the resource more sustainably.
 - » Ensure enforcement and regulatory compliance.



- Cultivation Activities
 - » Create a cultivation program using dredges without bags in the spring (April and the first two weeks of May) and the fall (August and September) each year.
- Cultch Plant Existing Public Reefs
 - » Increase the Shell Retention Fee to approximately \$1.00 to provide the resources needed to sustain existing reefs (See Appendix VII).
 - » Review the cultch planting process to develop an annual plan that defines exactly which reefs to plant, deploys cultch most effectively, and determines through cost-benefit analysis the type of material to be used.



- » Eliminate trawling and skimming on reefs.
- » Consider establishing a weight limit on bullets or skids not to exceed 450 pounds.

Encourage Private Leasing

- Oyster Relay Program
 - » Develop a program for private lease holders to relay oysters from public seed grounds.
 - » Consider relays from Telegraph Reef (and other similarly suited public reefs) to other public reefs to increase the chances of good spat sets' survival to maturity.
 - » Perform a feasibility study to determine best use of inactive relic shell deposits such as First Key, Pelican Key, and Umbrella Key.
 - Oyster Stewardship Program
 - » Continue educational programs for oystermen on proper techniques for more efficient harvest and health-and-safety protocol.
 - » Develop a training program designed to promote proper dredging techniques.
 - » Create a Certified Oysterman Program.
 - » Encourage entrepreneurs in the Oyster Industry to identify and create new gear.
 - » Utilize higher education community to play a key role in providing research, support, and teaching opportunities to help grow the Oyster Industry.
 - » Have MDMR and Secretary of State of Mississippi ("SOS") work closely with the University of Southern Mississippi's ("USM") Gulf Coast Research Laboratory, the Mississippi State University ("MSU") Coastal Research and Extension Center, and other institutions of higher learning, to provide research of the Oyster Resource and hands-on assistance for further training in the field of aquaculture as it relates to oyster farming.
 - Gear Recommendations
 - » Prohibit use of dredge designs that damage reefs.
- Develop a joint application and leasing process to satisfy all State and Federal agencies.
 - Remove the distance from shoreline limits for on- and off-bottom farming (unless inside tonging areas) to foster greater productivity.
 - Develop a program for private lease holders to relay oysters from public seed grounds.
 - Identify, permit and lease through United States Army Corps of Engineers ("USACE"), MDMR, SOS, Department of Archives and History ("MDAH") and other regulatory entities up to four suitable/viable areas for off-bottom oyster farming.
 - » Recommend MDMR serve as umbrella leaseholder with intent to sublease to farmers, thus streamlining the private leasing process.
 - Explore and implement tax incentives or other funding for matching programs.
 - Develop areas designed to load private vessels with cultch at one of the coastal public marinas.
 - Avoid user conflicts.
 - Establish and continue cooperative arrangements among various State agencies involved in the Oyster Industry to maintain streamlined, efficient, easily accessible processes to foster its expansion and to increase oyster production.



Promote Aquaculture, not just permit Aquaculture

- Increase commercial hatchery facility capacity to produce 10 Billion eyed larvae per year.
- Use Aquagreen as the primary hatchery, as recommended by the Hatchery Subcommittee.
 - » Utilize existing Mississippi hatcheries.
 - » Use facility that is “out of harm’s way.”
- Use Mississippi oysters as brood stock for the hatcheries.
- Utilize remote setting of hatchery-produced larvae on shell or suitable cultch material.
- Develop “best practice” model for numerous issues, e.g., remote setting, ideal water temperatures, salinity, pH, water circulation, etc., for best survival of larvae and spat-on-shell.
- Encourage researchers to develop faster growing, disease-resistant oysters — diploids and triploids.
- Increase and improve remote spat setting, transport, and planting capabilities to increase sustainable oyster production on public reefs, commercial reefs, and off-bottom oyster farming operations.

Offer Finance Program

- Maximize and leverage current funding streams.
- Encourage entrepreneurship.
- Consider creating a Shellfish Aquaculture Loan Program.
- Allow OEA or other personnel to assist with process.

Conduct Marketing

- SWOT analysis (Strengths, Weaknesses, Opportunities, Threats).
- Research best practices.
- Survey target audiences.
- Develop logo, tagline and branding materials.
- Develop and implement a five-year marketing plan and budget.





The background of the page is a photograph of a beach scene. In the foreground, there is a sandy beach with some small rocks and debris. The ocean is in the middle ground, with gentle waves breaking. The sky is filled with soft, white clouds. The overall color palette is muted, with a lot of beige, tan, and light blue tones.

Chapter 3

Oysters in the Economy Committee

Scope

The Oysters in the Economy Committee's scope is to develop bold but implementable management strategies and programs, based on the most authoritative research and reality-tested best practices that will enhance oyster production in the near term and for the long term.

Goal

The goal for the Oyster Council is to increase oyster reef productivity in the Mississippi Sound and produce One Million sacks of oysters annually by 2025. To reach that goal, the Oysters in the Economy Committee had a goal of developing a management strategy, including a plan for all aspects of resource management: restoration, enhancement, harvesting, and production.

The strategy starts with the above defined goal, defines activities to reach the goal, and then prioritizes when and where the activities should occur.



Issues that Should Be Addressed in the Near Term:

- Develop a clear, long-term management strategy and process.
- Streamline the complicated Private Lease process.
- Enhance enforcement to reduce theft and protect the resource.
- Increase education to reduce the occurrences of poor fishing techniques.

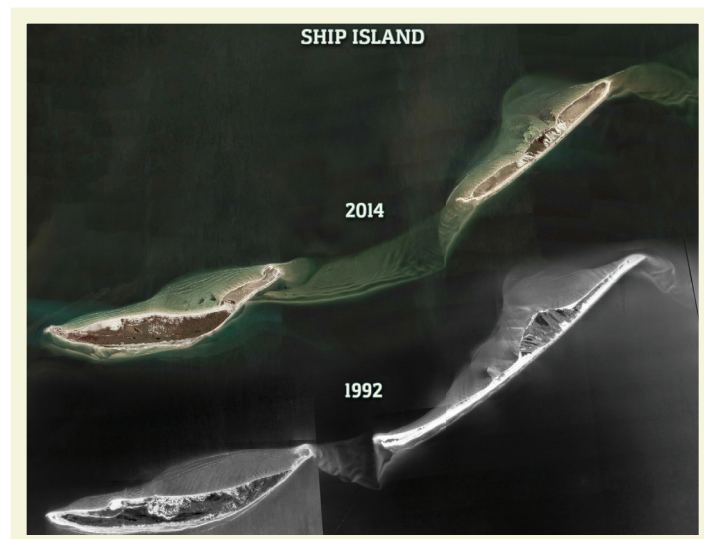
Issues that Should Be Addressed Long Term:

- Increase reef acreage, reef productivity, or both.
- Recognize that environmental changes over time have adversely affected many historical oyster reefs and grounds.
- Recognize occurrences of natural and man-made negative environmental conditions.
- Improve market's lack of recognition of the value of the Mississippi Oyster.

Challenges Facing the Oyster Industry

Many barriers exist to developing the Oyster Industry and several problems impede the Oyster Resource from growing. The Oysters in the Environment Committee chapter in the Report addresses these impediments and threats in greater detail.

Some barriers and challenges can be changed quickly by changing policies, for example, but others require more time.



Why Are We Doing What We Are Doing?

The Committee began its work when Chairperson Tish Williams asked a simple yet important question:

“Why are we - community and business leaders - involved in this effort?”

“If we don’t facilitate positive change, then we have failed,” said Williams.

Community and business leaders must be engaged in this effort to enhance and bring to light the importance of the Oyster Industry. The Committee recognized that for many years, the Oyster Industry thrived, but the triple whammy of Hurricane Katrina, the BP Oil Spill, and Bonnet Carré Spillway openings in 2009 and 2011 has driven it to a low point. The Oyster Industry has been struggling alone, but now with help, it again can thrive.

At the same time, for the Oyster Industry to be sustainable, the State should empower those in the Oyster Industry who are capable of entrepreneurship. The time to make these adjustments and modernize the State’s regulation of the Oyster Industry is now. This Committee has developed recommendations and implementable activities to limit any and all negative impacts that can be avoided, obviously understanding that hurricanes, oil spills, and spillway openings are beyond the State’s control.



“This effort and process should be ambitious, but practical and must make change to move the Oyster Industry into the current economy.”
- Jamie Miller.

Focus on Private Reef Enhancement

The Committee strongly recommends that the State encourage development of privately leased areas, which benefits economic and environmental interests. Through this effort, the State should create a regulatory and business environment that encourages oystermen to invest in a Private Lease in Mississippi.



To attract oystermen to develop and invest in Private Leases in Mississippi, the leasing process must be simplified. The State Legislature did address the lease issue in the 2015 session and passed House Bill 879, which was a major step in the right direction. The Oyster Council recognizes and appreciates the Legislature’s support. However, a number of regulatory impediments to Private Lease holdings have yet to be addressed. The Permit Simplification Subcommittee of the Aquaculture and Emerging Technologies Committee addresses this issue in more detail, but the Oysters in the Economy Committee recommends the following:



- Develop a joint application and leasing process to satisfy all State and Federal agencies.
- Create the position of Oyster Extension Agent funded through MDMR to facilitate the private leasing process and aquaculture permitting.
- Remove the distance from shoreline limits for on and off-bottom farming (unless inside tonging areas) to foster greater productivity.
- Develop a program for Private Lease holders to relay oysters from public seed grounds (more details below).
- Satisfy the MDAH requirement to survey for shipwrecks and other potential historical finds through the State's mapping program.
- Encourage the State to apply for and receive permits from the USACE under which private leaseholders, both on- and off-bottom, can operate.
- Explore and implement tax incentives or other funding for matching programs to encourage initial investment for private leasing, aquaculture activities, and dockside services.
- Develop areas to load private vessels with cultch at one of the public marinas, preferably at Pass Christian or Bayou Cadet.
- Avoid user conflicts (tongers versus dredgers, in-state tongers versus out-of-state tongers, in-state fishing interests versus out-of-state fishing interests, Bayou Cadet fishing interests versus Pass Christian fishing interests, etc.).

What's good for the public reefs is good for Private Leases. As public grounds improve, a program should be developed to provide permission for Private Lease interests to relay oysters in order to seed the private oyster lease areas. These relays should be from unharvestable areas to harvestable areas. The Committee does not propose allowing private leaseholders to move oysters below market size from public reefs with the intent to harvest. The intent of the program is purely to provide seed, not immediate commercial product.

MDMR must ensure that these reefs are not over-harvested because they will be needed for future restoration efforts and are a source of brood stock. Prior to opening an area for this type of relay, MDMR should perform a stock assessment and prescribe a quota for the relay in an amount not to exceed the replacement rate of the reef or develop and use the Shell Budget Model or other no-net change based model.

Restore and Improve the Public Reefs

The State should improve the current public reefs contemporaneously with identifying and growing additional public reef areas. The State should focus on improving the status of the existing harvestable public reefs for local oystermen and enhancing the unharvestable public reefs for brood stock and as seed grounds for Private Leases.



Mapping and Sampling to Establish a Baseline

The State quickly must perform a major mapping exercise to get an updated reef assessment and to determine areas with suitable substrate and conditions for additional reef growth.

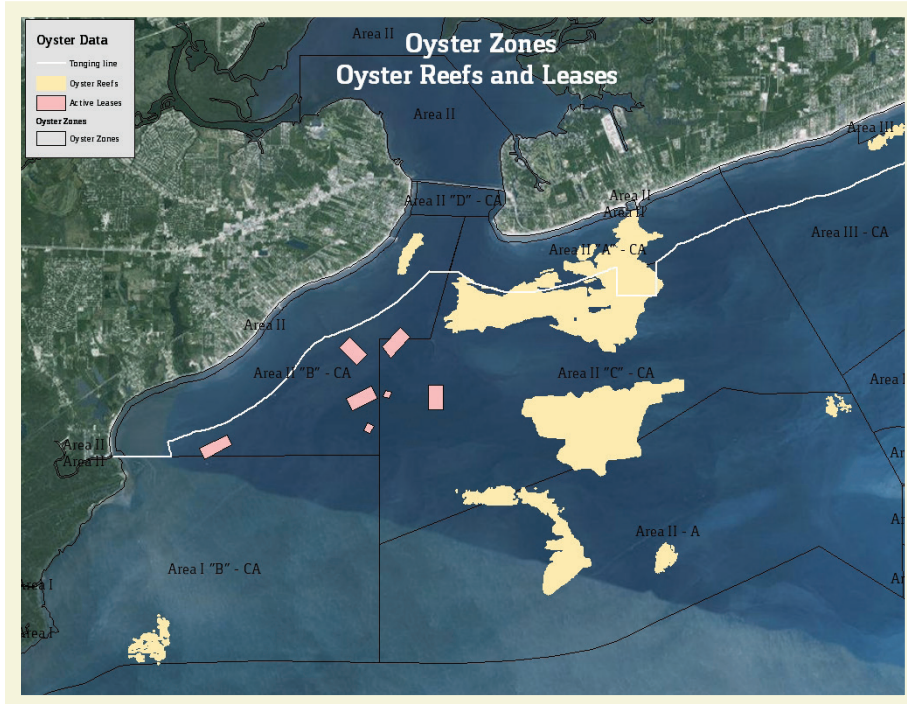
Recommendations:

- Use side scan sonar that would be verified in the field by ground-truthing.
 - » Begin with detailed mapping of the Western Mississippi Sound.
 - » Mapping must include bottom type to identify areas suitable for leasing and future cultch plants for public reef expansion.
 - » See Aquaculture and Emerging Technology Subsection "Technologies and Best Management Practices."



- Continue to sample annually with a focus on developing a stock assessment or model that can be utilized for sustainable harvest.
- Develop maps of areas to cultch, to relay from and to, and to target for reef creation and recreation, both private and public. Input should be gathered from all interested parties, oystermen, researchers, and managers.
- Prevent conflicts of use through Suitability Mapping to layer in and identify stakeholders who use the bottoms.

improving the monitoring and safety controls over the oyster harvest. However, significant discussion took place regarding harvesting and sustainability. The Committee understands there are factors that influence the Oyster Resource that even the Best Management Practices (“BMPs”) cannot prevent, including oil spills, hurricanes, disease and spillway openings. To increase the opportunity for success in oyster production and sustainability, the Committee recommends that the following management strategies and plans be considered, vetted and then implemented:



“You have got to know what you are working with,” said Michael Cure II.

- Identify and model hydrological and salinity regimes
 - » Identify threats and restoration projects currently planned that may affect salinity, such as the restoration of Ship Island to the 1900 footprint and flood control proposals for the Pearl River.

Harvesting–Reef Rotation and Quotas

Mississippi is a regional and national leader in managing oyster harvests using effective monitoring and safety protocols. The Committee agreed with Dr. Benedict Posadas of the MSU Coastal Research and Extension Center when he said, “Mississippi oysters are the safest in the Gulf.” Because of the great work the State has done, little discussion was given to

- Adopt management practices and metrics to assess health of reefs and to determine harvest capacity, by way of sacks, not days.
- Open and close specific reef areas based on projections that leave sufficient biomass for a sustainable or increasing fishery for the following year.
- Consider using the Shell Budget Model or other no-net change based model as basis and verifying by field sampling or establishing quotas (in terms of number of sacks to be harvested) based on projections that leave sufficient biomass for a sustainable or increasing fishery for the following year.
- Allow for higher sack per day limit (up to 50 sacks per day) to encourage oystermen to use efficiency to create a higher upside for themselves.

- Allow off-bottom farmers on Private Leases to harvest oysters smaller than three inches to meet the demands of the boutique half shell oyster market.
- Improve enforcement of harvesting BMPs.
- Consider adjusting the Tong Line to comport with reef conditions.
- Consider increasing fees for out-of-state licenses.

Cultivation Activities

Cultivation is pulling bagless dredges over reefs to expose fresh shell or other substrate. Cultivation is performed to clean fouling organisms and sediment off of the shells, which allows for an area more suited to an oyster spat set. In addition to clean fouling, cultivation redistributes material across the reef and can help reduce hooked mussel infestations.

Timing is very important as to when cultivation is performed. If it is done too early, the organisms and sediment have time to re-foul the substrate; too late, and the dredge will damage and destroy the spat, or the spat will be missed altogether.



Recommendations:

- Create a cultivation program using dredges without bags in the spring (April and the first two weeks of May) and the fall (August and September) each year.
 - » For small cultivation activities, the State should consider using the MDMR oyster lugger, *Conservationist*, with the assistance of oystermen. This is an ideal project for a formal Oyster Stewardship Program.
 - » For a larger, routine cultivation program, the State should consider hiring a private contractor to manage.
- Increase the Shell Retention Fee to approximately \$1.00 to sustain the existing reefs (See Appendix VII).
- Use the Shell Retention Fee as leverage or match to additional funding sources.
- Review the cultch planting process to develop an annual plan that defines which reefs to plant, deploys cultch most effectively, determines through cost-benefit analysis the type of material to be used, and allows for sufficient closing of the reef post-cultching to benefit spat settlement and growth.
- Discourage the use of barges in shallow oyster reef areas.
- Use smaller, nimble boats to plant cultch in shallow water.
- Consider the use of shell as the base for new reef establishment.
 - » Shells should be used for planting to make a good bottom base in new reef construction.
 - ◇ Shells should be completely dry and bleached, to prevent slime and offer optimal surface for spat to catch.
 - ◇ Consider use of a shell veneer, crushed concrete, or limestone for cultch plants on existing natural reefs or cultch plants.

Cultch Plant Existing Public Reefs

Cultch planting involves placing oyster shells, crushed concrete, or limestone on the bottom to provide areas for oyster larvae to attach. Every sack that is harvested from a reef takes aggregate and substrate with it. Over the past several years, the State has done a good job of increasing reef acreage by building new reefs, and at the same time, the State has deployed significant resources to reestablish existing reefs.

Both activities are necessary and should be continued and improved. The Committee recommends the following regarding cultch planting existing public reefs:



Oyster Relays

Oyster relay projects move viable oysters from areas of high abundance to areas with lower abundance or to areas more suitable to the growth and survival of the oysters. The relay can be performed by a single contractor with sufficient staff and equipment or by multiple commercial oystermen to a barge for transport and deployment to a receiving area for harvest. Prior to conducting an oyster relay, the State samples the area to ensure the oysters are of sufficient size to survive the relay and to determine how many sacks should be relayed. Typically, a relay program moves un-harvestable oysters to harvestable areas. The Committee recommends the following regarding oyster relay projects and programs:



- The State should consider including commercial oystermen in relays when economically feasible.
- Relays from any donor reef should include mapping and assessment to determine the sustainable amount of oysters to be removed from the reef area by either an established quota, Shell Budget Model, or other assessment that accounts for the replacement rate of the donor reef.
- Initial relay harvesting locations are Heron Bay, Bay of St. Louis, Biloxi Bay, Graveline Bayou, and Pascagoula River but should be field verified for suitability.
 - The State should consider relays from Telegraph Reef (and other similar public reefs) to other public reefs to increase the chances of

good spat sets' survival to maturity.

- The State should perform a feasibility study to determine the best use of inactive relic shell deposits such as First Key, Pelican Key, and Umbrella Key.

Stewardship and Technical Assistance

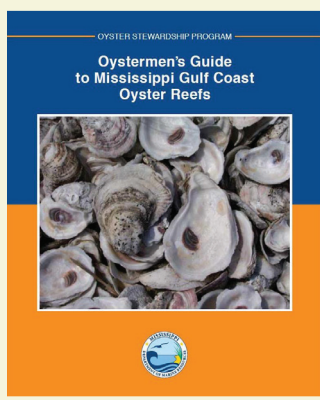
Over the years, a tremendous amount of time, money, and effort have been put forth on restoration efforts to improve the Mississippi Oyster Resource. MDMR has an effective stewardship program, but it can be improved. The State should continue to make every effort to encourage oystermen to use practices that allow them to utilize the State's Oyster Resources but that are environmentally conscious. The Committee believes that the encouragement of good stewardship of the Oyster Resources has the potential to yield tremendous returns and recommends the following:

For Oystermen

- Continue educational programs on proper techniques for more efficient harvest and health and safety protocol.
- Create a training program designed to promote proper dredging techniques.
 - » Have experienced dredgers teach inexperienced dredgers how to work dredges without bogging, overloading, or damaging reefs.
- Continue and improve the Oyster Stewardship Program.
- Create a Certified Oysterman Program.
- Enlist oystermen for paid and voluntary oyster reef cultivation projects.

For MDMR

- Establish a shell recovery program.
 - » Shells recovered from processors, restaurants, and other end users will be used in oyster farming, gardening, and reef creation and restoration.
 - » Encourage MDMR to seek funding to support these types of programs or seek legislation that provides tax incentives for processors and restaurants to return shell to the State.
- Implement a program to promote sustainability that estimates the annual amount of oysters available for harvest from each major reef and a mechanism to ensure that harvesting is stopped



when that threshold is reached.

- Encourage entrepreneurs in the Oyster Industry to identify and create new gear.

Gear Restrictions

From its initial meeting, the Committee discussed a number of recommendations regarding gear restrictions or modifications, providing for use of different gear types for oyster dredging and researching lighter dredges to reduce impacts to reefs. Based on reality-tested best practices, the Committee determined to recommend the Mississippi Commission on Marine Resources eliminate use of the basket dredge.



- Prohibit use of dredge designs that damage reefs.
- Eliminate trawling and skimming on reefs to prevent damage to reefs and death of spat.
 - » MDMR could use the Shrimp Hotline to discourage trawling on oyster reefs.
- Establish a weight limit on bullets or skids not to exceed 450 pounds.

“You don’t want to plow the reefs with your dredge, just tickle the top,” said Michael Cure II.

Finance and Marketing

The Committee strongly recommends the State encourage entrepreneurship to grow and diversify the Oyster Industry. Private Leases (on- and off-bottom), the development of aquaculture, and the promotion of dockside services encourage the development of systems to provide spat on shell, places to load vessels with cultch material, and other services

needed by leaseholders. Given the current condition of the Oyster Industry, the State should develop grant opportunities, loan programs, or other funding mechanisms to match or encourage entrepreneurs to invest in oyster production. The Committee recommends the following to the State:

Finance

- Maximize and leverage current funding streams.
- Consider creating a Shellfish Aquaculture Loan Program.
 - » Use the program in Maryland as an example.
 - » No collateral should be required.
 - » Require owner equity, i.e., investment, of 10 percent.
 - » Require an effective business plan and good credit.
 - » Allow loans in good standing to be partially forgivable.
 - » Target loans to specific aquaculture assets.
 - » Allow proceeds to be used for shell and aquaculture specific equipment.
 - » Do not allow proceeds to be used for boats, trucks, etc.
 - » Allow OEA or other personnel to assist with process.

Marketing

While production increases as the result of the Oyster Council’s recommendations, efforts should begin on a marketing campaign for branding “The Mississippi Oyster.” The materials should create a premium perception among consumers to maintain high sales prices even with an increase in supply.

The biggest kept secret....Dr. Benedict Posadas, “Mississippi oysters are the safest in the Gulf.”

- SWOT analysis (Strengths, Weaknesses, Opportunities, Threats).
 - » Conduct thorough SWOT analysis about Mississippi oysters and their perception in the consumer and wholesale marketplaces, and identify marketing opportunities and threats.
- Research best practices.
 - » Expand review to include best practices used for other “commodity” type products – potatoes, meat, almonds, oranges, onions, etc.
 - » Understand pipeline of Mississippi oyster

- production to the open market and how packaged.
- » Research marketing impacts and opportunities of aquaculture-produced oyster product.
- » Interview resellers regarding their packaging and interest in incorporating a “Mississippi Made” oyster designation.
- Survey target audiences.
 - » Poll stakeholders and develop list of Mississippi oyster selling points.
 - » Expand data collected into a survey for social media to gather consumer feedback.
 - » Develop a second survey for distribution to culinary industry members (chefs, restaurants, distributors, etc.).
 - » Narrow responses to three to five unique or distinguishing things about Mississippi oysters.
- Develop logo, tagline, and branding materials.
 - » Extend creative components to include examples of how the brand could translate to packaging, collateral, and online presence.
- » Secure vanity URL for landing page/web presence for food industry professionals.
- Develop five-year marketing plan and budget.
 - » Initial branding and public relations press kit materials.
 - » Targeted industry and consumer media pitches.
 - » Industry and chef/food-related event appearances.
 - » Trade publication advertising.
 - » Point of sale materials for restaurants and grocery stores that support locally, wild-caught seafood.

“It’s not the State’s job to provide fishermen a paycheck. It is the responsibility of the State to be good stewards of the resource,” said Harold Strong.





The background of the page is a photograph of a beach and ocean. The foreground shows the wet sand of a beach with some small waves and foam. The middle ground is the ocean, and the background is a hazy, distant shoreline under a cloudy sky.

Chapter 4

Oysters in the Environment Committee

Scope

The Oysters in the Environment Committee's scope is to improve, restore and enlarge Mississippi's Oyster Resources, enhance water quality in growing and harvesting areas, create habitat and develop a long-term resource management plan geared toward increasing the oyster population for environmental, social and economic benefits.

Goal

The Committee's goal is to increase the quantity and quality of Oyster Resources for habitat creation, for environmental benefits, and for production and consumption. The Committee identified environmental threats impacting oysters and then proposed solutions to address the identified threats. Solutions were then prioritized.



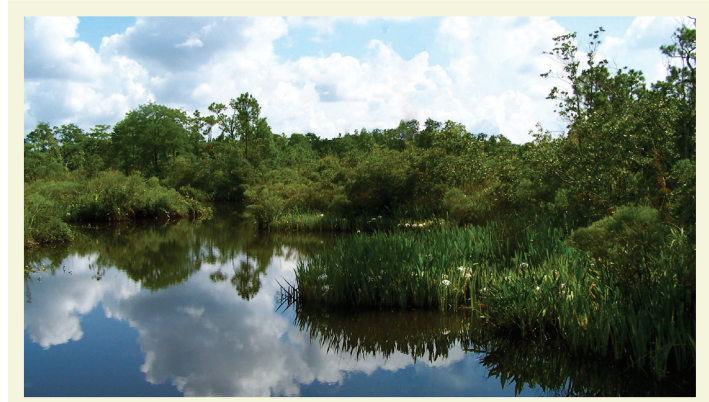
Challenges Facing the Oyster Industry

Environmental factors impacting oysters include acute and chronic impacts and consist of a complex set of natural and manmade challenges. The Committee organized and divided these challenges into the following four threat categories or Threats to Success:

- Insufficient fresh water quantity.
- Impaired water quality.
- Limited suitable substrate.
- Existence of negative non-environmental factors.

The Four Threats to Success

The Mississippi Gulf Coast environment encompasses an extensive, integrated array of ecosystems, habitats, and natural resources, which provide recreational and commercial opportunities for residents and visitors. Mississippi's coastal and marine environment extends from the intertidal to the oceanic zones including estuaries, coastal streams, bays, the Mississippi Sound, barrier islands, beaches, intertidal ecosystems, tidal and freshwater wetlands, and benthic environments. These habitats are rich sanctuaries of biodiversity and can influence the development and success of Oyster Resources.



These habitats exist as the cultural fabric connecting the Mississippi Gulf Coast - economically, environmentally, and socially. Simply put, the preservation and enhancement of the coastal environment is necessary to preserving the way of life in coastal Mississippi. Mississippi's abundant water resources, and the natural ecological systems connected by them, underpin virtually all facets of life on the Gulf Coast. For long term resiliency, this Committee believes stakeholders have a duty to encourage and promote thriving habitats, such as the barrier islands and coastal marshes. At the same time, a plan should be put forth to improve and re-establish under-performing habitats. Repaired, resilient coastal habitats contribute to a healthy environment, protect coastal communities, provide a line of defense against powerful storms, and preserve a high quality of life.

To achieve success, the Committee identified threats to oyster habitat and production and determined the root causes of the threats. From there, the Committee explored solutions to address each root cause. Finally, the Committee outlined goals and solutions and prioritized the solutions. Four matrices developed for the threats can be used as reference guides

for the Committee's chapter of the Report. (See Appendices III through VI.)



Threat to Success - Insufficient Fresh Water Quantity

Oysters require an aquatic environment of favorable tides, currents, and freshwater inflow. Oysters thrive in areas where they can be protected from full ocean salinity and fed by fresh water from rivers, streams, or bayous. Appropriate salinity levels are necessary for the oyster to survive predation and disease. Over the course of time, the flow of freshwater into and across the Mississippi Sound has been altered, contributing to lower production and survival in historical oyster reef areas.

Contributing factors to insufficient water quantity include the following:

- Alterations in the amount of and natural fluctuation in freshwater inflow.
- Lack of freshwater retention.
- Saltwater intrusion.
- Incomplete knowledge of controlling ecological factors.

Each of these contributing factors exists through a

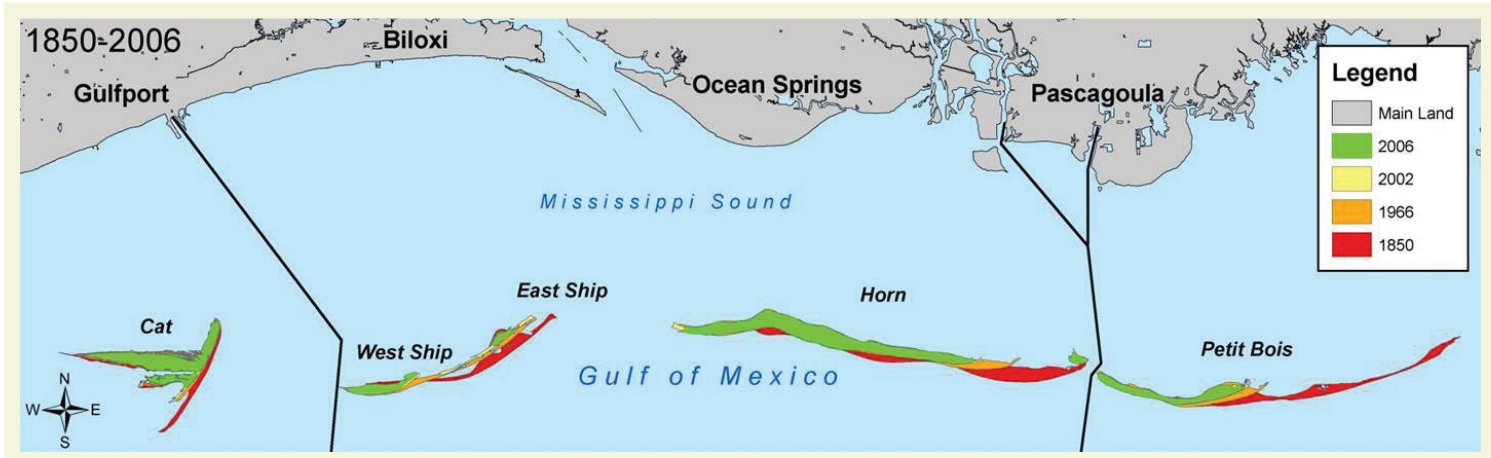
series of root causes, which can overlap at times. The altered amount of freshwater flow across and into the Mississippi Sound was likely caused by and is exacerbated by the creation of dams and other structures upland, water removal for human use (residential, commercial, and industrial), and channelization.

Lack of fresh water retention is the inability of the Mississippi Sound to maintain freshwater levels near shore or oyster habitats. Saltwater intrusion is the encroachment of high salinity water closer to shore and further into rivers and streams. The lack of freshwater retention and the increase in saltwater intrusion are factors caused by the reduction in the amount of wetlands and barrier island erosion. Barrier island erosion and the deepening of navigation channels contributes to increased salinity levels in the Mississippi Sound.

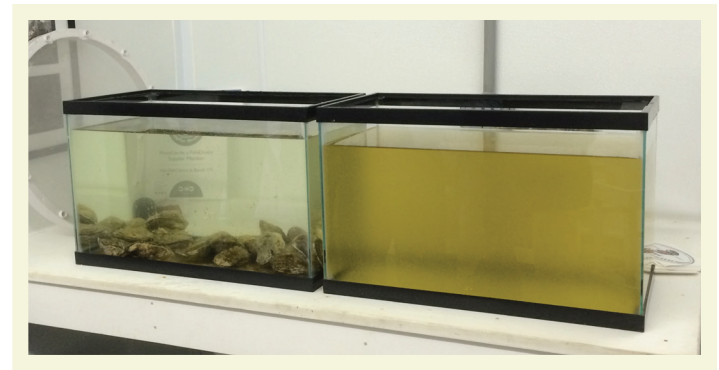
Another threat to water quantity is the lack of knowledge about how BMPs affect the ecological fabric of the coastal environment. Enhanced monitoring and assessment, as well as hydrological model development, are solutions to be considered.

Water Quantity Recommendations for Action or Research

- Continue barrier island restoration.
 - » Ship Island, Chandeleur Island, Three Mile Pass, Nine Mile Pass.
 - » Utilize strategic placement of sediment from navigation channel dredging between islands.
- Create additional marsh and habitat.
 - » Build living shorelines and natural approaches to shoreline stabilization.
 - » Encourage restoration and green practices.
 - » Evaluate closure of specific canals to allow for marsh restoration.



- Focus land acquisition, conservation, and restoration efforts in historical oyster producing watersheds.
- Commission a regional, integrated watershed management plan.
 - » Implement BMPs.
- Enhance modeling of hydrological patterns and salinity.
- Improve streamside management.
- Discourage freshwater depleting projects and educate decision-makers on impacts of major freshwater-depleting projects.



Threats to water quality include:

- General impairment.
- Non-point source pollution.
- Point source pollution.
- Vessel discharges.
- Ocean acidification.

General Impairment of Water Quality

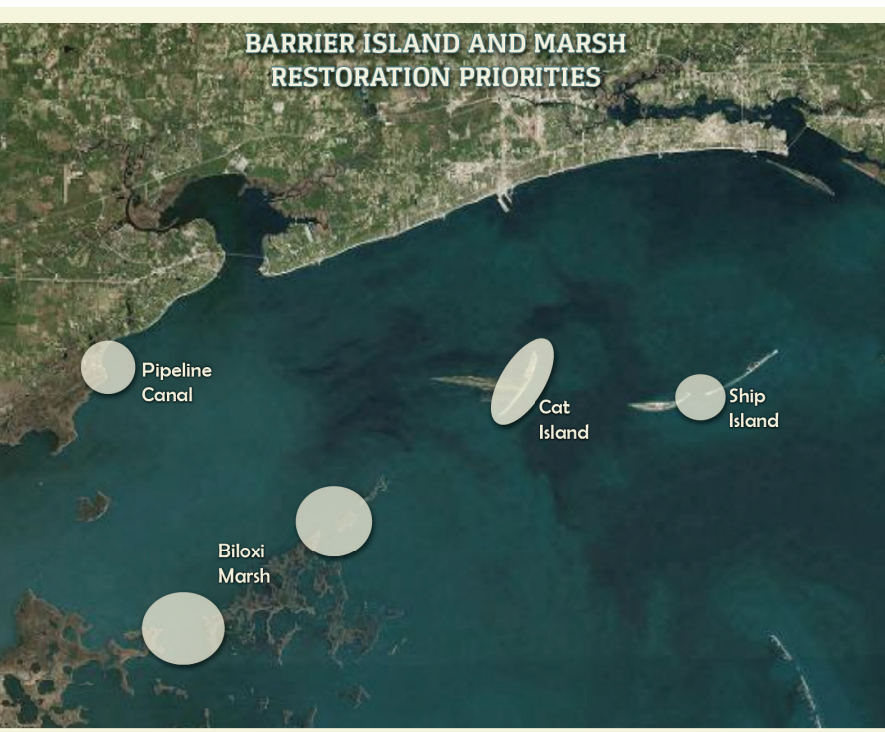
General impairments to water quality include acute stressors and chronic stressors. Acute stressors impacting water quality consist of events such as hurricanes, oil spills, and bio toxins. Chronic stressors include increased nutrients causing dead zones and eutrophication, increased pathogens, non-point pollution due to changes in land use upstream, and loss of a natural vegetated buffer at the water's edge.

The Committee identified the following goals to mitigate the acute and chronic stressors causing general impairment of water quality:

- Establish more resilient and sustainable policies to reduce the frequency of oil spills and to better prepare for and recover from weather-related events.
- Reduce nutrients loading.
- Remove or repair leaking septic systems.
- Reduce sedimentation.
- Increase vegetated buffers and green infrastructure.
- Encourage stakeholder engagement.

To achieve the above goals, the Committee proposed to explore the following overarching solutions:

- Promote resilient practices and policies including more resilient marinas, resilient ports, and resilient communities.



Threat to Success - Impaired Water Quality

Water quality is key to healthy and vital ecosystems and habitats in the Gulf that support fish, shellfish, aquatic vegetation, wetlands, and birds. Water quality is fundamental for a healthy, resilient Gulf and is threatened by various impairments which vary greatly from one-time events such as major storms to the continuous effects from upstream land use. Though water quality impairment can have a negative impact on oyster production and harvest, the reverse also holds true.

- Adopt hazard mitigation plans and pollution prevention plans to focus on protection of natural resources (oyster beds) in the event of storms.
 - » Focus on implementing sustainable practices and eliminating the source of potential pollution before any storm event.
 - » Suggested uses include shut-down pumps, portable bathroom facilities, securing industrial sites, and securing storm-resistant shelters for oils, chemicals, and products used at maintenance facilities, municipal barns, and other structures.
- Provide incentives to reduce nitrogen and phosphorus and other nutrients at both the industrial and municipal levels.
- Increase coordination for permitting and inspecting septic systems among Mississippi State Department of Health (“MDOH”), MDMR, and Mississippi Department of Environmental Quality (“MDEQ”).
- Promote green infrastructure throughout the watershed.
- Encourage living shorelines and natural approaches to shoreline stabilization.
- Address socio-science connections.
- Increase public outreach with translators at meetings.



Point Source and Non-Point Source Pollution

The Committee identified contributing factors of point source and non-point source pollution. Point source pollution is water pollution that comes from a single point, such as the discharge pipe from a wastewater treatment facility. Non-point source pollution is water pollution discharged over a wide area – such as roadway runoff – not from one specific point. The root causes of point source pollution are industrial, municipal wastewater systems, and mouth-of-river discharges into the Mississippi Sound. Non-point source pollution originates from storm water runoff

from parking lots, roads, and lawns, as well as land disturbance activities such as construction, failing onsite wastewater systems, and wildlife.

The Committee identified the following goals to mitigate the cause or impact of point source and non-point source pollution of water:

- Reduce nitrogen and phosphorus and other nutrients.
- Reduce oil and grease.
- Reduce sedimentation and turbidity.
- Reduce heavy metals.
- Reduce pathogens, viruses, and harmful bacteria.
- Reduce harmful algal blooms.

To achieve the above goals, the Committee proposes to explore the following overarching solutions:

Non-point Source Pollution

- Identify and evaluate through sanitary and shoreline surveys all actual or potential pollution sources that may impact the classification of shellfish growing areas (required in ISSC Model Ordinance and conducted by MDMR).
 - » Recommend routine surveys and share findings with MDEQ and other coordinating agencies.
 - » Prioritize according to the extent of their potential impact on the area classification or potential threat to product safety.
 - » Contact responsible person or governing (regulatory) authority for the actual or potential pollution source to rectify the problem.
 - » Strengthen the communication and the coordination between MDEQ, MDMR, MDOH, and the violator.
- Suggest regulatory and legislative changes to mitigate cause and impact.
- Explore in detail the contaminant of concern and the toxicity levels to humans and to oysters and then consider “treatment” options - relaying, purging, depuration, etc.
- Develop a specific plan to remove storm water drains from beach areas.
 - » Identify a capture or containment system to collect storm water runoff.
 - » Treat storm water and release the clean, fresh water into areas near oyster beds to provide the valuable freshwater resources needed.
 - » Result is two issues addressed:

- ◇ Reduced non-point source pollution through the elimination of some storm water on coast and provision of clean, fresh water.
- Implement storm water treatment train approach at locations where storm water runoff is adjacent to historic oyster bed areas.
- Improve the communication and outreach to upstream partners.
- Explore existing relationships with United States Department of Agriculture (“USDA”), The Nature Conservancy (“TNC”), MSU Extension Center, etc. to coordinate the outreach message.
- Recommend “One Mississippi” – we are all connected, upstream land use affects downstream resources and downstream water quality impairment affects upstream quality of life issues.
- Demonstrate connectivity.... positive changes will be beneficial to all.



- Offer incentives to reduce non-point and point source pollution.
 - » Example – tax incentives to farmers who reduce nutrients, enact significant irrigation reuse practices, and reduce storm water runoff, etc.
- Development of storm water management plans at the local (city/county) levels.
 - » These plans will provide the following:
 - ◇ Focus on prevention versus treatment.
 - ◇ Public education.
 - ◇ Public involvement.
 - ◇ Encourage pollution prevention/good housekeeping at potential storm water sources.

- ◇ Identify and eliminate illicit discharges.
 - ◇ Identify construction sites and provide enforcement at the local levels.
 - ◇ Address post-construction storm water runoff.
 - ◇ Implement specific and efficient BMPs depending on storm water source.
- Engage MDOH to monitor and enforce residential wastewater land application discharges and to locate and inspect potential failing systems.
- Either implement repairs of failing systems or connect these to wastewater collection systems.
 - » Develop monitoring plans to evaluate in-streams conditions and identify and prioritize areas of concern.
 - » Examples include the work being done in Rotten Bayou and Turkey Creek.

Point Source Pollution

- Identify and map industrial and municipal National Pollutant Discharge Elimination System point source locations (majors and minors) and receiving waters relative to oyster bed locations.
- Identify the oyster beds in proximity of outfalls and areas with contamination concerns.
 - » Explore the feasibility of re-locating those outfalls to locations of no potential impact.
 - » Propose special evaluation or monitoring of these outfalls where it does not currently exist, and assess level of potential contamination to oyster beds.
- Based on bacteria data and sanitary surveys, identify those beds that are classified:
 - » Approved.
 - » Conditionally approved.
 - » Restricted.
 - » Conditionally restricted.
 - » Prohibited.
- Establish water quality monitoring stations at the mouth of all river discharges into the Mississippi Sound to evaluate any and all potential pollutants entering the Mississippi Sound.
 - » Identify those inflows with gauging stations and continuous monitoring stations and use this information to assess water quality.
- For Municipal Separate Storm Sewer System (“MS4”) permitted entities:
 - » Require inspections.
 - » Adopt Model Ordinance.
 - » Identify clear enforceable actions.
 - » Identify clear line of communication.

- » Prepare handouts or develop stakeholder engagement campaign.

Other contributing factors identified by the Committee are vessel discharges of onboard wastewater, fuel, or cargo spills, and ocean acidification. The overarching solutions to address these threats follow:

Vessel Discharges

- Evaluate the current laws in place that address onboard wastewater discharges.
- Identify problem areas of onboard wastewater discharges, for example, fish camps.
- Engage United States Coast Guard (“USCG”) to monitor and enforce laws.
- Explore Clean Water Act (“CWA”) Section 312 that allows states to designate waters as “no-discharge zone” for vessel sewage discharges, especially in sensitive shellfish areas.
- Explore mandatory marine sanitation services on all vessels of a certain length or greater.
- Encourage the Resilient Marina Program – resilient and clean marinas can be certified, i.e., recognized for providing services such as free and convenient pump-out facilities.
- Develop a stakeholder engagement campaign.
- Educate and engage the public to report fuel/cargo spills and environmental incidents to the National Response Center (1-800-424-8802).
 - » Rapid and efficient response is the best tool to combat spills.

Ocean Acidification and Hypoxia

- Develop and implement monitoring program.
- Review current literature and develop BMPs for handling future events.



Water Quality Recommendations for Action or Research

Once the overarching solutions to address each specific threat to water quality were established, the Committee prioritized the solutions as follows:

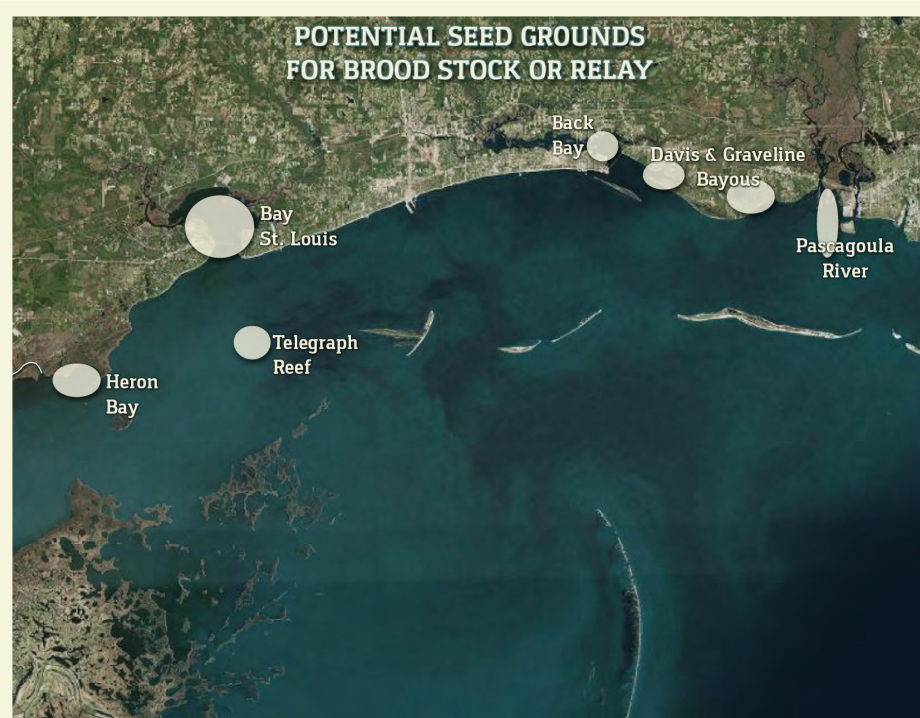
- Play detective for each water body -- use “fingerprinting” to identify contaminants.
 - » Research if impairment exists.
 - » Link to cause.
 - » Research trends.
 - » Identify solutions.
- Target at-risk areas and areas for potential for harvesting and employ location-specific remedies to address identified water quality concerns.
 - » Classify areas.
 - » Use hydrographic studies including bacterial source tracking.
 - » Continue research and water quality monitoring, improvement of technology, and fingerprinting of pathogens.
 - » Continue to gather data at weather stations.
- Storm water management.
 - » Give enforcement grants for storm water management plans at local level.
 - » Eliminate untreated storm water drains on Coast.
 - ◇ Collect.
 - ◇ Treat.
 - ◇ Release.
 - » Manage upstream storm water.
 - » Reduce point and non-point source pollution.
 - » Promote living shorelines and green infrastructure practices.
 - » Establish oyster farming projects using students and baskets.
 - » Utilize storm water BMPs or “treatment train” approach adjacent to oyster habitat.
 - » Consolidate and treat storm water prior to discharge.
 - » Conduct storm drain and septic system inspections.
- Education and Outreach.
 - » Create points of interests for tourists numbered with Oyster Information/Oyster Stewardship Program/Oyster farming projects/Prohibit Live-Aboards/ Use Pump-Out Stations, and No Dumping, etc.



- Require resilient practices at marinas, ports, industrial facilities, and communities.
- Continue coordination of MDOH, MDMR, and MDEQ efforts.
- Develop Regional Oyster Restoration, Enhancement, and Expansion for Sustainability (“REEFS”) Plan with a systems approach focused on sustainability. The REEFS Plan recommendations are as follows:
 - » Link historic oyster bed areas to specific threats. The Committee recommends beginning with the identification and investigation of threats for individual historic areas such as Biloxi Bay, Graveline Bayou, Mouth of Pascagoula River, Pass Christian.
 - » Conduct stepwise and routine habitat and bottom mapping.
 - » Link waterbody impairment to specific cause(s).
 - ◇ “Fingerprint” fecal coliform.
 - ◇ Investigate emergency contaminants of concern such as pharmaceuticals.
 - ◇ Investigate non-point and point sources of pollutions.
 - » Investigate salinity and flow changes over time through modeling hydrological and salinity patterns.
 - » Expand Coastal Stream Assessment Project to all coastal streams within five years.
 - » Enhance monitoring and assessment.
 - » Develop Integrated Watershed Management Plans.
 - » Continue to focus on barrier island restoration and coastal marsh restoration.
 - » Encourage aggressive storm water

management and treatment – treatment “train” approach.

- » Promote living shorelines and green infrastructure.
 - » Increase stakeholder engagement and outreach.
- The following areas are recommended as project priority areas:
 - » Biloxi Bay.
 - » Bay of St. Louis.
 - » Graveline Bayou.
 - » Off Mouth of Pascagoula River.
 - » Henderson Point.
 - » Grand Bay NERR.



Threats to Success - Limited Suitable Substrate

Oyster reefs require hard bottom habitat and exist through an accumulation of live oysters, shell and other suitable substrate on which oysters can affix. Reefs grow by having generations of oysters reproduce and grow in one place over time. Natural oyster reefs consist of shell on hard bottom, and reefs can be created by cultch planting (shell, concrete or limestone) on hard bottom. Areas within the Mississippi Sound offer ideal aquatic conditions to encourage oyster production and survival; however,

many of these areas do not have the water bottom characteristics necessary to support an oyster reef. As such, the Committee recognized limited suitable substrate is a threat to success of greater oyster production in Mississippi.

The Committee divided the threats and associated root causes to limited suitable substrate as follows:

- Lack of data regarding resource quantity, location and delineation.
 - » Insufficient planning for future reef expansions by sediment type.
 - » Lack of sufficient benthic habitat mapping.
- Change in substrate over time, affecting suitability for oyster production.
 - » Caused by sediment contamination, accretion, and scouring.
- Substrate removal or disturbance.
 - » Harvesting or over-harvesting.
 - » Dredging.
 - » Shrimping.
- Improper or inefficient reef restoration methods.
 - » Use of ineffective substrate material.
 - » Lack of availability of effective materials (shell).
 - » Inadequate cost-benefit analysis.
- Ocean acidification and hypoxia in areas with otherwise suitable substrate.

- Include depositional rates (and characteristics of deposited sediments - linked to sediment contamination, accretion, and scouring below) for sediment source identification and threat to suitability.

Change in Substrate over Time, Affecting Suitability for Oyster Production

- Conduct routine or event-specific habitat mapping and accompanying sediment sampling to characterize geochemical properties.
- Deploy scouring plates on legacy reefs (and new cultch) to assess intensity of sloughing/scouring.
 - » Relate to experimentation of spat settlement in flume tanks.
- Analyze suspended sediment/detritus versus spat settlement rates in legacy reef and cultch areas.
 - » Include periodic toxicity assessments.



Suitable Substrate Recommendations for Action or Research

Lack of Data Regarding Resource Quantity, Location and Delineation

- Develop, fund, and implement a comprehensive habitat mapping plan, which includes routine mapping, sediment sampling, and analysis of rates of deposition and erosion.
- Take stepwise approach for localized to coast-wide habitat mapping.
 - » Start mapping program of historical reef areas and expand outward to delineate bottom characteristics.
- Create substrate suitability maps using Habitat Suitability Indices (“HIS”) informed by surveys.
 - » Determine substrate type/mixture via penetrometer.
 - » Analyze sediment core, including temperature, salinity, dissolved oxygen, and particulate organic carbon.

Substrate Removal or Disturbance

- Consider adoption of a Shell Budget Model or other no-net change model to manage the annual harvest more sustainably.
- Develop a Shell Recycling Program.
- Assess fishing impacts on reefs to include substrate removal and burial.
- Develop/update coastal substrate management plan to maximize retention of shell resources and substrates beneficial for propagation of oyster reefs.
- Assess the direct and indirect effects of sediment contamination, accretion, and scouring on water quality.
- Manage dredging and shrimping practices which affect sediment disturbances.
- Incentivize oyster processors to preserve shell for cultch material.
- Incentivize oyster processors to return live sub-market sized oysters to the reef.

Improper or Inefficient Reef Restoration Methods

- Evaluate literature and review, and conduct field-based experiments to determine optimum cultch material for various bay systems.
 - » Material may be effective, but not ideally located; use HIS maps to inform placement.
- Fund comprehensive cost-benefit analysis.
 - » Perform cost-benefit analysis for available cultch types.
- Create shell retention and shell return requirements.
- Assess experimental reef material.
 - » Explore alternate reef-building materials.

Ocean Acidification and Hypoxia

See Water Quality Subsection regarding Ocean Acidification and Hypoxia.

Threat to Success - Existence of Negative Non-Environmental Factors

Oysters can be impacted by a number of environmental factors as identified by the Committee—insufficient fresh water quantity, impaired water quality, and limited suitable substrate. In addition to the environmental threats, Oyster Resources face numerous non-environmental threats jeopardizing their survival or limiting their ability to thrive.

The contributing factors the Committee determined to be primary and their root causes include:

- User conflicts including homeowners, recreational boaters, commercial fishermen, pipelines, navigation channels, and Federal, state and local entities and uses.
 - » Negative perception by homeowners that Oyster Resource or activities diminish aesthetic values, tourism, or other economic opportunities.
 - » Commerce demands (navigation and pipelines).
 - » Economic development.
 - » Increased populations in coastal zones.
 - » Limited resources or geographic constraints on aquatic habitat, i.e., shrimping grounds and recreational fishing areas versus reef development.
 - » Unintended conflicts such as municipal needs over resource needs.

- Use of improper equipment and harvesting gear due to insufficient instruction, knowledge, or old habits.



- » Improper use of gear [dredge flipping (basket versus bag), weight, line scope, etc.].
 - » Lack of research on improved methods or impact to the resource.
 - » Gear preferences.
- Conflict of local, regional, or political interests stemming from limited resources and regional perceptions and attitudes.
 - » Limited resources (partitioning resources, geographic resources).
 - » Perception or attitudes.
 - » Lack of cohesive planning for the entire Gulf Coast. Continued turf and political boundaries remain challenging.
 - » Regionalism (Pine Belt, Delta, versus Coastal needs and desires).
 - » Priorities other than for natural resources.
- Regulatory challenges due to often disputed, multi-level regulations.
- Poor management decisions because of industry pressure, resource closures, and conflicting regional interests.
- Lack of environmental regulatory enforcement.
 - » State agencies' lack of enforcement.
 - » Regulations may not have consequences to force compliance.
 - » Perception of accountability (see oil slick, don't see dead oysters).
- Lack of public awareness because of loss of connectivity to the resource.
- Lack of funding.

Non-Environmental Threat Recommendations for Action or Research

User Conflicts

- Education and Outreach.
- Community planning and stakeholder inclusion.
- Zoning regulations to deal with runoff, storm water (retention and detention ponds), and materials.
- Citizen scientist/build a reef as an outreach project (schools, civic groups, etc.)(non-production reef projects/living shoreline).
- Simplify permitting process for neighborhood reefs and fishing structures (oyster reefs).
- Suitability mapping to insure the resources are being utilized in a fair, equitable, and sustainable manner.

Use of Improper Equipment and Harvesting Gear

- Education and outreach for oyster fishermen.
- Research on gear impacts and research to improve gear technology/efficiency.

Conflict of Local, Regional, or Political Interests

- Education and outreach for bigger ecosystem value.
- Community projects (i.e. Adopt a Reef, shell recovery, citizen contributions) (Coast-wide community projects).
- Developing political will and advocacy.

Regulatory Challenges

- Streamlining of regulatory process and procedures.

Poor Management Decisions

- Education about value beyond fishery.
- Move to stock assessment process for the resource.
- Education about larger picture for region as a whole.

Lack of Environmental Regulatory Enforcement

- Education followed by consequence (increasing consequence).
- Enforcement of zoning regulations for point and non-point source pollution.

Lack of Public Awareness

- Stewardship projects (living shoreline, shell recovery projects, etc.).
- Education and outreach (public service announcements, schools, scouts, coastal history, etc.).
- Promotion of green infrastructure, tying benefits to the resource.

Lack of Funding

- Integration of resource stewardship into existing/future municipal projects (roads, storm water, etc.).
- Consideration of mitigation options.





The background of the page is a photograph of a beach and ocean. The foreground shows the sandy beach with some small waves and foam. The middle ground is the ocean, and the background is a hazy, distant shoreline under a cloudy sky.

Chapter 5

Aquaculture and Emerging Technologies Committee

Scope

The Aquaculture and Emerging Technologies Committee's scope is aquaculture for both stock enhancement and commercial production; restoration for protected areas to enhance habitat and to encourage farming, including use of public and private leased areas; and study and selection of best emerging technologies to implement aquaculture programs for economic and environmental purposes.

Goal

Increase the amount of oysters in the Mississippi Sound through stock enhancement and commercial aquaculture. Promote aquaculture-based farming, remote setting and hatchery best practices; improve and expand public reefs on public grounds; and identify and employ emerging technologies to increase the number of oysters. Create an environment in which entrepreneurs will be interested in investing in aquaculture and in which private leasing has a strong chance of success and is encouraged, not *discouraged* by government.



Challenges Facing the Oyster Industry

- Lack of a coordinated, clear management strategy process and use of best practices.
- Legislative and regulatory provisions that do not allow for off-bottom Private Leases, making a slow, cumbersome permitting process, and limiting proximity to shore.
- Cumbersome Private Lease process.
- Insufficient enforcement of various agency regulations. (See the Oysters in the Environment Committee chapter for details.)
- Insufficient reef acreage, reef productivity or both.
- Absence of a dedicated marketing strategy to promote "The Mississippi Oyster" as a brand the public wants above others.
- Lack of comprehensive public education regarding importance of oysters to the economy and environment.
- Insufficient education of the Oyster Industry about best practices, emerging techniques and technologies, and related subjects.
- Lack of adequate and targeted funding to enhance and sustain growth of the Oyster Industry, both public and private.

New Organizations and Tools Necessary to Implement the Oyster Council's Report

Over the course of the Oyster Council process, the Aquaculture and Emerging Technologies Committee recognized a clear need to form entities and further develop partnerships necessary to implement the recommendations of this Committee and the Oyster Council Report. Without the following implementation tools and organizations, the Committee believes the Report may not have the impact it could. As such, the Committee recommends the following:

- Form Oyster Recovery Partnership— Private sector NGO/non-profit to facilitate implementation of the projects and programs recommended in this report and be a platform for regular communication and coordination.
 - » Governor-appointed board of up to seven members chosen from the private sector – business, the community, and Oyster Industry leaders.
 - » Participation by designees of each agency and institution in mandated meetings, on a

recommended bi-monthly basis for the first three years.



- Convert Oyster Council Executive Committee to an official advisory role, recommended to be called the Oyster Advisory Council (“OAC”).
 - » OAC to participate in mandated meetings with the ORP, MDMR, SOS, USACE, National Oceanic and Atmospheric Administration and representatives of institutions of higher learning.
- Designate an Oyster Extension Agent within MDMR to facilitate and coordinate aquaculture and private leasing requirements, processes, and activities.
 - » The OEA will assist an aquaculture or farmer applicant in completing the single comprehensive application for a Private Lease (on- or off-bottom) or an aquaculture project.
 - » OEA will take the application through rest of State and Federal process.
 - » OEA will assist farmers in completing business plans where necessary for funding or insurance.

The Three Subcommittees

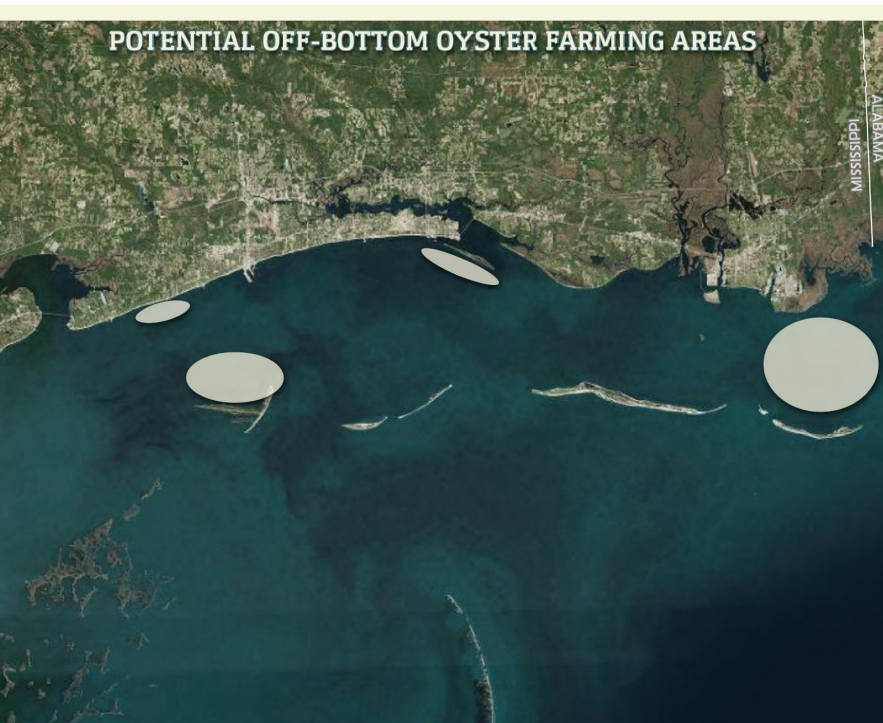
The Committee divided into subcommittees to focus on three areas within its scope: permit simplification, hatchery, and technologies. From these subcommittees have come the following programs, priorities, and recommendations.

Permit Simplification Subcommittee

Preface: From the onset of the Oyster Council, stakeholders throughout the Oyster Industry highlighted that the Private Lease process was too complicated and too burdensome to encourage entrepreneurs to invest. At the same time, each primary committee is strongly recommending that more Private Leases are needed to increase production. The Legislature, with House Bill 879, took a great step in the right direction to encourage investment in Private Leases, and this Subcommittee recommends the following to build upon that effort:



- Identify and permit up to four suitable/viable areas for off-bottom oyster farming.
- Have State agency obtain the appropriate permit(s) from USACE for suitable/viable areas for off-bottom oyster farming.
- Create an umbrella lease managed by a State agency that is then sub-leased to interested farmers, thus streamlining the private leasing process.
- Utilize emerging technology, benthic habitat mapping, and sampling of environmental parameters to identify the growing areas most suitable for on- and off-bottom farming. Suitability mapping reduces user conflicts and locates areas to provide the best rate of success for oyster farmers, giving them a greater opportunity to succeed and to produce a healthy and bountiful crop of oysters.



- Enable the agency to identify specific areas available for lease by agreeing on the best locations based on the mapping data provided.
- Verify mapping and other uses of technology with field testing, e.g., poling (automated and manual) data.
- Create comprehensive applications and lease forms for use by oyster farming applicants. Applications may require the submission of a business plan and other relevant information as part of verification of viability of the individual projects.



Secretary of State Delbert Hosemann

- Establish and continue cooperative arrangements among various State agencies involved in the Oyster Industry to maintain streamlined, efficient, easily accessible processes to foster its expansion and to increase oyster production.
- Anticipate, propose, and guide to adoption necessary legislative and regulatory adjustments to enhance the ongoing success of the Oyster Industry.
- Educate, inform, and train the public on this exciting opportunity.
- Utilize the higher education community to play a key role in providing research, support, and teaching opportunities to help grow the Oyster Industry.
- Have MDMR and SOS work closely with USM's Gulf Coast Research Laboratory, the MSU Coastal Research and Extension Center, and other institutions of higher learning, to provide research of the Oyster Resource and hands-on assistance for further training in the field of aquaculture as it relates to oyster farming.

Hatchery Subcommittee

Preface: To increase Mississippi's oyster production to a sustainable One Million sacks per year and to increase ecological and economic benefits will require concerted efforts on many fronts. Hatcheries are a major, vital part of this plan.



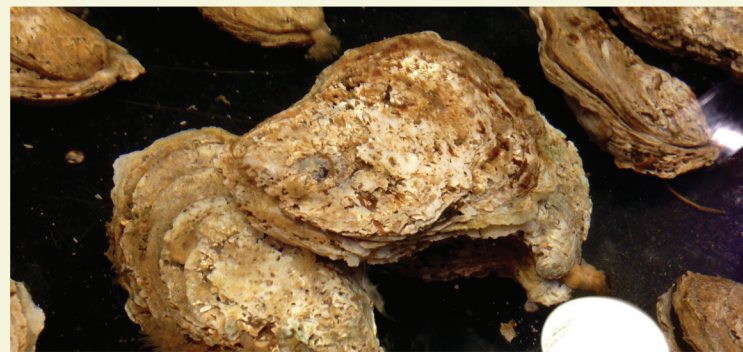
“What’s good for public reefs is good for privately leased areas.” - Corky Perret, MDMR, (retired)

Recommendations:

- Utilize existing Mississippi hatcheries, instead of building a new one.
 - » Hatchery Subcommittee members visited several Mississippi facilities to include: Aquagreen near Perkinston, Mississippi, privately owned; Crystal Seas in Pass Christian, Mississippi, where currently oyster larvae are being purchased from Louisiana for remote cultch setting, i.e. spat-on-shell; Gulf Coast Research Laboratory's Cedar Point facility; and Lyman Aquaculture Center, which is operated by MDMR.
- Use Mississippi oysters as brood stock for the hatcheries.
- Produce large volumes of oyster larvae in Mississippi hatcheries, with an overall goal of 10 Billion eyed larvae per year.
- Develop system for sufficient water quality in the hatchery.
 - » Use of a hatchery with a continuous source of sufficient quality water or with a closed circulation system should alleviate this problem by being able to control temperature, salinity, and water chemistry.
 - » Oyster hatchery operations in other parts of the United States (Louisiana, Virginia, and Washington State) have been hampered by insufficient water quality (acidification, salinity, etc.).
- Use facility that is "out of harm's way." Storms have been and will continue to be catastrophic to coastal hatcheries. A facility that is operational following such events is a must for continuous production.
- Provide facility with ability to produce massive amounts of algae to feed larvae.
- Utilize remote setting of hatchery-produced larvae on shell or suitable cultch material. Remote setting is a process where oyster larvae attach or settle on cultch material. The newly attached oysters, called seed, then rest in a nursery area to provide protection before they are re-located into the wild or farmed area. MDMR could provide hatchery larvae and spat on cultch to public reefs; Private Lease holders could provide this larvae and cultch to their Private Leases.
- Develop "best practice" model for numerous issues. For example, remote setting, ideal water temperatures, salinity, pH, water circulation, etc., for best survival of larvae and spat-on-shell.



- Encourage researchers to develop faster growing, disease-resistant oysters — diploids and triploids.
- Remove the distance from shoreline limits for on- and off-bottom farming (unless inside tonging areas) to foster greater productivity.
- Additionally, while not specifically within the Hatchery Subcommittee's charge, efforts must be made to:
 - Improve water quality.
 - Expand public reefs on public grounds.
 - Construct new reefs.
 - Expand private leasing and relaying.
 - Initiate off-bottom farming.
 - Ensure adequate supply of cultch material (oyster shells, Eocene shell bed quarry mining, crushed limestone, concrete, etc.).
- Provide low interest loans to qualified lease holders (See more specific information on revolving loan program in the Oysters in the



Economy Committee chapter of this Report.).

- Provide or enable access to "crop insurance" for lease holders.

Summary:

For a successful hatchery operation, the Hatchery Subcommittee recommends a partnership among the public sector, research universities, and the private sector. MDMR is the agency tasked with the responsibility of managing and marketing

Mississippi's marine resources. Academia should be used for research, operational assistance, and teaching facilities. The private sector should develop privately leased areas, thus increasing the acreage where oysters are produced and can be harvested, participate in the use of and adjustment to best practices, both for management and actual production, and serve as a resource for the ongoing growth of the Oyster Industry.

- Aquagreen is recommended by the Hatchery Subcommittee as the primary hatchery for the following reasons:
 - » The facility is already built and could be ready for operation in a short period of time.
 - » Funds are available. Funding of Two Million Dollars was provided by the Mississippi Legislature to USM in the State budget for fiscal 2016 to operate this facility.
 - » The facility is out of harm's way.
 - » The facility could be retrofitted to produce large volumes of larvae. Given that recirculating aquaculture for oyster production has not been tested on large scales, an experiment should take place to ensure this facility is a viable option for producing oyster larvae.
 - » Larvae produced could be sold to private companies for use on their Private Leases or could be utilized for seeding the public grounds after remote-setting has occurred.

If the experiment at the Aquagreen facility is successful, operations could incorporate the other referenced aquaculture facilities as needed to obtain maximum overall hatchery capability, utilization, and output.

Once hatchery production is online, the Hatchery Subcommittee believes that a barge equipped with a flow-through seawater system could be utilized to transport larvae and spat-on-shell to identified public seed grounds along the Mississippi Gulf Coast. A hatchery onboard a barge could be developed, allowing for the possibility of relocation should water quality become an issue.

While other hatchery efforts exist throughout the United States, each continues to experience challenges that are difficult to overcome with their current approaches. What will make the Mississippi Hatchery different, environmentally and economically?

It will take full advantage of partnership opportunities and will exist as a network of hatcheries, not just a stand-alone. A successful public, academic, and private aquaculture partnership will put Mississippi in the forefront of oyster hatchery production, research, and distribution. Significant existing infrastructure will be utilized to leverage the costs required to meet the challenge of sustaining One Million sacks of Mississippi oysters annually. Capitalizing on the collective wisdom of government agencies, institutions of higher learning, and the private sector will foster an environment of creative tension enabling Mississippi to break through limitations that have existed for many years in the Oyster Industry.

Technologies and Best Management Practices Subcommittee

Operating Assumptions:

- Applying new technologies and best management practices to meet stated production goals begins with an enhanced Oyster Resource Management Program that provides a baseline survey of oyster reefs in areas classified as approved, conditionally approved, restricted, and prohibited that addresses spatial extent, volume, and oyster stocks.
- Evaluating results of new techniques and technologies requires a comprehensive Oyster Reef Reference Area where techniques and technologies are implemented but not open to harvesting, along with annual oyster stock analysis, quantitative landing data, and reef condition monitoring (shell volume/spatial extent) to ensure the yields are sustainable.
- Increasing oyster production and meeting sustainable fishery goals necessitates the State ordering its priorities and focusing on the most productive areas to make them more productive.
- Consider incentivizing the development and operations of the priorities below through tax credits or other means.



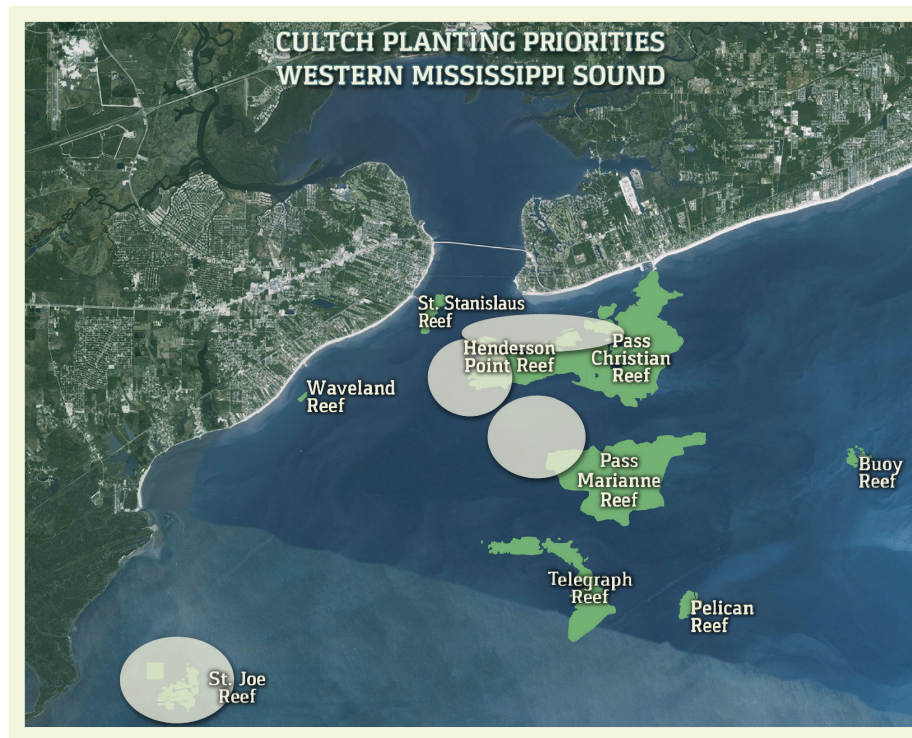
Priority 1: Enhance oyster production on existing Mississippi Sound public reefs.

Priority 2: Facilitate new reef construction by the private sector in suitable leased areas.

Priority 3: Facilitate off-bottom commercial oyster farming operations.

Summary of Technology and Best Management Practices Prioritized Recommendations:

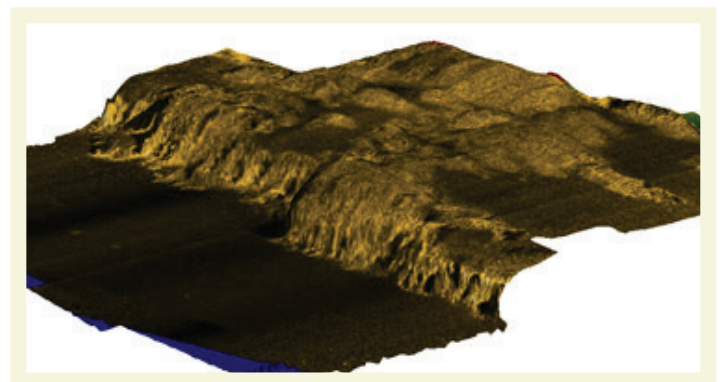
- Implement comprehensive relay/transplant programs from “controlled” areas in Mississippi Sound and associated estuaries. Utilize Mississippi-based oystermen as relay specialists where possible.
- Increase commercial hatchery facility capacity to produce 10 Billion eyed larvae per year as the basis for:
 - » Enriched recruitment on public reefs.
 - » Increased stock and recruitment to accelerate oyster production on new reefs.
 - » Enhanced seed stock for off-bottom, commercial oyster farming operations.
- Increase and improve remote spat setting, transport, and planting capabilities to increase sustainable oyster production on public reefs, commercial reefs, and off-bottom oyster farming operations.
- To decrease mortality, develop new disease-resistant oyster stocks cooperatively with research universities and commercial hatcheries. Emphasize triploid stock production that could create disease-resistant strains and lead to longer harvesting seasons.
- Conduct baseline public oyster reef assessment using interferometric sonar technology (i.e., enhanced side scan sonar) to depict three-dimensional bathymetry, spatial extent, reef volume, and adjacent substrate. Prepare tidelands spatial platform consisting of cumulative reef analyses and oyster stock measurements to monitor reef change and adaptively manage oyster stock in the Mississippi Sound.



Specifics of the Three Priorities:

Priority 1: Enhance oyster production on existing Mississippi Sound public reefs.

- Conduct comprehensive baseline oyster reef map survey of spatial extent, physical characteristics, reef topography, and surrounding substrate with phase differencing bathymetric sonar and sub-bottom profilers (available carbonate substrate with geo-referenced locations). Mapping information from baseline and subsequent surveys will be accessible online to the public and potential lease holders to support decisions that affect private reef construction and off-bottom oyster farming operations.



Source: NOARC via www.edgetech.com

- Conduct comprehensive oyster stock assessment (baseline) utilizing accepted sampling methodologies.
- Conduct periodic oyster transplant (relay) from controlled areas to take advantage of entire oyster production region in the Mississippi Sound and monitor donor reef volume and topography to ensure donor reef sustainability (balance between harvested oysters and replacement oyster stock).



- Apply oyster cultch to targeted public reefs to increase larval recruitment in season (paying close attention to precise application to targeted reef locations). Target a 10 percent increase in actively harvested public reef acreage each year for 10 years.
- Increase surface area to expand public and private reef acreage.
- Increase availability of hatchery-produced oyster larvae.
- Develop remote spat setting facilities, transport systems, and “planting systems.”
- Develop new disease-resistant oyster stocks for distribution to public reefs, commercial reefs, and off-bottom oyster farming operations. Implement public/private partnerships between commercial hatcheries and research universities to focus on triploid oyster larvae production to create superior oyster strains and longer harvesting seasons.
- Identify high-priority reef locations for optimized application of larvae and spat-on-shell.
- Conduct quantitative annual reef monitoring, stock assessments, and landings data collection. Target outcome: increase productivity with no net loss of stocks or substrate.
- Operate oyster reef reference areas, where no commercial harvesting will take place, to assess enhancement results and serve as the baseline for evaluating sustainable yields and harvesting

effects on public reefs.

- Examine new oyster dredging techniques and reef cultivation techniques that increase marketable oyster production on public and private reefs and encourage increased spat recruitment by managing reef surface area more effectively.

[The third through the seventh bulleted recommendations under Priority 1 also apply to Priorities 2 and 3 below.]



Priority 2: Facilitate new reef construction by private sector in suitable leased areas.

- Identify suitable areas for new reef construction and commercial leasing near high production reefs (indicative of high recruitment rates) and validate with proven hydrology models over the candidate areas.
 - » Consider developing new structure with carbonate base of alternative materials with veneer of oyster shell (optimum reef elevation should achieve at least one foot above initial grade).
 - » Validate reef construction results with quantitative spatial survey.
- Facilitate a simple regulatory framework that is not cost-prohibitive to commercial investment and sustainable Private Lease operations (e.g., lease terms). In a comprehensive program for leasing, the lease should require at least 20 percent active work annually on leased areas. The term “active work” should be defined by MDMR.
- Design financial (revolving loan program) and risk management (oyster “crop” insurance) incentives that encourage long term investment in Private Lease operations.

- Construct Oyster Reef Reference Areas to assess enrichment techniques and to serve as a baseline for evaluating effects of oyster harvest on Private Leases.
- Facilitate a simple oyster-farming regulatory framework that encourages commercial investment and sustainable farming operations, e.g., long term lease, and that addresses oyster cleansing/certification processes.
- Design financial (revolving loan program) and risk management (crop insurance) incentives that encourage long term investment in commercial oyster farming operations.
- Consider low-risk proof-of-concept sites for farming technique validation and risk management analysis. It appears that a major role for research universities to partner with commercial operators is in developing and testing off-bottom farming techniques.

Priority 3: Facilitate off-bottom commercial oyster farming operations.

- Identify and pre-qualify candidate bottomlands for off-bottom oyster farming operations (substrate, hydrology, proximity thresholds to submerged aquatic vegetation, natural sites, navigation channels, archaeological clearance, oyster farming, effluent discharges, etc.).





Chapter 6

Acknowledgement by Chairman Dave Dennis and Executive Director Jamie Miller

As, respectively, Executive Director of MDMR and Chairman of the Governor's Oyster Restoration and Resiliency Council, we extend our thanks to the men and women who volunteered their time to the Oyster Council. Without their hard work, along with that of a number of MDMR staff, this Report would not have been possible.

Governor Bryant set a high bar for success, and within a short timetable, the Oyster Council accomplished the goals set forth. We are ready and eager to begin the process of implementing the Report's recommendations.



Dave Dennis
Chairman
Governor's Oyster Council



Jamie Miller
Executive Director
Mississippi Department of
Marine Resources



Appendix I

Acronyms Used in Oyster Council Report

BMP:	Best Management Practice(s)
CWA:	Clean Water Act
HSI:	Habitat Suitability Indices
MDEQ:	Mississippi Department of Environmental Quality
MDAH:	Mississippi Department of Archives and History
MDMR:	Mississippi Department of Marine Resources
MDOH:	Mississippi State Department of Health
MSU:	Mississippi State University
NGO:	Non-governmental Organization
NOARC:	National Oceans and Applications Research Center
OAC:	Oyster Advisory Council
OEA:	Oyster Extension Agent
ORP:	Oyster Recovery Partnership
REEFS:	Regional Oyster Restoration, Enhancement, and Expansion for Sustainability
SOS:	Secretary of State of Mississippi
SWOT:	Strengths, Weaknesses, Opportunities, Threats
TNC:	The Nature Conservancy
USACE:	United States Army Corps of Engineers
USCG:	United States Coast Guard
USDA:	United States Department of Agriculture
USM:	University of Southern Mississippi



Appendix II

Selected References and Resources

Comparison of Reef Openings between Louisiana and Mississippi by John Veazey, Regional Shellfish Specialist, United States Food and Drug Administration, April 21, 2015. www.dmr.ms.gov. (Under Agency Information drop down, click on Governor's Oyster Council. Download for PDF of presentation is at bottom of screen.)

Executive Order 1350, issued by Governor Phil Bryant, February 2, 2015. www.governorbryant.com. (Under drop down for News, click on Executive Orders and look for EO 1350.)

Go Coast 2020 Final Report, January 2013. www.gocoast2020.com.

House Bill 879, effective July 1, 2015. www.legislature.ms.gov. (On homepage, select House bills, click on bill number, fill in 879, and click search.)

Oyster Management in Louisiana, Power Point Presentation (includes Shell Budget Model) by Louisiana Department of Wildlife and Fisheries to the Oyster Council, April 21, 2015. www.dmr.ms.gov. (Under Agency Information drop down, click on Governor's Oyster Council. Download for PDF of presentation is at bottom of screen.)

Oystermen's Guide to Mississippi Gulf Coast Oyster Reefs. Mississippi Department of Marine Resources, August 2013. www.dmr.ms.gov. (Under Communications drop down, click on Publications, then look for 2013 Oystermen's Guide.)

Shellfish Aquaculture Leasing, Power Point Presentation by Karl Roscher, Director, Aquaculture Division, Maryland Department of Natural Resources, Fisheries Service. 2015. www.dmr.ms.gov. (Under Agency Information drop down, click on Governor's Oyster Council. Download for PDF of presentation is at bottom of screen.)

The Oyster Fishery of the Gulf of Mexico United States: A Regional Management Plan, 2012 Revision, Publication 202. Gulf States Marine Fisheries Commission, March 2012. www.gsmfc.org. (Under Publications drop down, click on Complete List of Publications, then look for Publication 202.) (A good source for many of the oyster-related terms used in the Oyster Council Report).



Appendix III

Insufficient Fresh Water Quantity Matrix		
Contributing Factors	Root Causes	Solutions to Explore
Alterations in the amount of and natural fluctuation in freshwater inflow	Upland water management control structures <ul style="list-style-type: none"> • Reservoirs • Dams Water removal for human use <ul style="list-style-type: none"> • Residential • Commercial • Industrial Channelization	<ul style="list-style-type: none"> • Commission regional integrated watershed management and BMPs • Discourage freshwater depleting projects by educating decision-makers • Improve streamside management • Build living shorelines • Focus land conservation in historical oyster producing watersheds
Lack of freshwater retention	Reduction in amount of wetlands Barrier island erosion	<ul style="list-style-type: none"> • Create additional marsh and habitat • Build living shorelines • Continue barrier island restoration • Strategically place navigational channel dredging sediment • Focus land conservation in historical oyster producing watersheds
Saltwater intrusion	Reduction in amount of wetlands Barrier island erosion Deepening of navigation channels	<ul style="list-style-type: none"> • Create additional marsh and habitat • Build living shorelines • Continue barrier island restoration • Strategically place navigational channel dredging sediment • Hydrological and salinity model development
Incomplete knowledge of controlling ecological factors	Lack of comprehensive data collection and integration for development of ecology-based BMPs	<ul style="list-style-type: none"> • Enhanced monitoring and assessment • Hydrological and salinity model development



Appendix IV

Impaired Water Quality Matrix				
Contributing Factors	Root Causes	Goals	Solutions to Explore	Prioritization of Solutions
General impairment	<p>Acute Stressors</p> <ul style="list-style-type: none"> Hurricanes/Storms Oil spills Bio-toxins/HABs <p>Chronic Stressors</p> <ul style="list-style-type: none"> Dead zone Eutrophication Pathogens Land use change upstream Loss of swath of natural vegetated buffer at water's edge Loss of coastal connection 	<ul style="list-style-type: none"> Reduce frequency of events and intensity of damage Prepare for weather events and recovery Reduce nutrients loading Reduce/Repair leaking septic systems Reduce sedimentation Increase vegetated buffer Encourage stakeholder engagement 	<ul style="list-style-type: none"> Promote resilient marinas, ports and communities Adopt hazard mitigation and pollution prevention plans to protect oyster beds from storms Implement sustainable practices and eliminate source of potential pollution before storm event Suggest use of shut-down pumps, secure industrial sites, secure storm-resistant shelters for oils/chemicals/products, etc. Provide incentives to reduce nitrogen, phosphorus and other nutrients at industrial and municipal levels Increase coordination for permitting septic systems in current or potential watersheds near oyster habitat among MDOH, MDEQ, and MDMR Promote green infrastructure throughout the watershed Encourage living shorelines Address socio-science connections Increase public outreach with translators at meetings 	<ol style="list-style-type: none"> Play detective for each water body. Research if impairment exists and link to cause <ul style="list-style-type: none"> Target at risk areas and areas for potential for harvesting Classify areas Use hydrographic studies including bacterial source tracking Continue research and water quality monitoring, improvement of technology and fingerprint pathogens Continue to gather data at weather stations Storm water management <ul style="list-style-type: none"> Give storm water management plans enforcement grants to local level Eliminate storm water drains on coast Manage upstream storm water Reduce point and non-point pollution Promote living shorelines/green infrastructure pilot projects Establish oyster farming projects Use storm water BMPs adjacent to oyster habitat Treat storm water before discharge Inspect storm drain and septic systems Education and Outreach <ul style="list-style-type: none"> Create points of interests for tourists with oyster information, oyster stewardship program and oyster farming projects Promote resilient practices at marinas, ports, industrial facilities, and communities Continued coordination of MDOH, MDMR, MDEQ efforts Develop REEFS management plan with systems approach focused on sustainability Specific project areas: <ul style="list-style-type: none"> Biloxi Bay Graveline Bayou Off Mouth of Pascagoula River Henderson Point Grand Bay NERR

Impaired Water Quality Matrix

Contributing Factors	Root Causes	Goals	Solutions to Explore
Non-point source pollution	<p>Storm water runoff</p> <ul style="list-style-type: none"> • Parking lots • Roads • Roofs • Lawns • Urban areas <p>Land Disturbance</p> <ul style="list-style-type: none"> • Construction • Farming • Silviculture • Septic systems • Wildlife 	<ul style="list-style-type: none"> • Reduce nitrogen • Reduce phosphorus • Reduce oil and grease • Reduce sedimentation • Reduce turbidity • Reduce heavy metals • Reduce pathogens • Reduce viruses • Reduce bacteria • Reduce algal blooms 	<ul style="list-style-type: none"> • Identify and evaluate through sanitary and shoreline surveys all actual or potential pollution sources that may impact classification of shellfish growing areas (required in ISSC Model Ordinance and conducted by MDMR) <ul style="list-style-type: none"> ◦ Recommend routine surveys and sharing of findings with MDEQ and other agencies ◦ Prioritize according to the extent of their potential impact on the area classification or potential threat to product safety ◦ Contact responsible person or governing authority for actual or potential pollution source to rectify problem ◦ Strengthen communication and coordination between the MDEQ, MDMR, MDOH, and the violator • Suggest regulatory and legislative changes • Explore the contaminant of concern and toxicity levels to humans and to oysters, then consider “treatment” options—relaying, purging, depuration, etc. • Develop plan to remove storm water drains from beach areas <ul style="list-style-type: none"> ◦ Identify capture or containment system to transport and collect storm water runoff ◦ Treat storm water and release it near oyster beds resulting in both reduced pollution and the provision of clean water to oysters • Implement storm water treatment train approach where storm water runoff is adjacent to historic oyster bed areas • Improve communication and outreach to upstream partners • Explore relationships with USDA, TNC, MSU Extension Center, etc. to coordinate the outreach message of “One Mississippi” • Offer tax incentives to farmers who reduce storm water runoff, etc. • Develop storm water management plans at local levels to focus on prevention vs. treatment and public education

Impaired Water Quality Matrix		
Contributing Factors	Root Causes	Solutions to Explore
Non-Point source pollution (continued)	Failing onsite wastewater systems	<ul style="list-style-type: none"> Engage MDOH to monitor and enforce residential wastewater land application discharges to locate and inspect potential failing systems Implement repairs of failing systems or connect them to wastewater collection systems Develop monitoring plans to evaluate in-streams conditions and identify/prioritize areas of concern <ul style="list-style-type: none"> Examples include the work being done in Rotten Bayou and Turkey Creek
	Wildlife	
Point source pollution	Industrial Municipal wastewater systems <ul style="list-style-type: none"> Incorporated Unincorporated 	<ul style="list-style-type: none"> Identify and map industrial and municipal NPDES point source locations (majors and minors) and receiving waters relative to oyster bed locations Identify those oyster beds in proximity of outfalls and areas with contamination concerns Explore relocating those outfalls to locations of no potential impact Propose special evaluation or monitoring of these outfalls and assess level of potential contamination to oyster beds Based on bacteria data and sanitary surveys, identify beds classified as approved, conditionally approved, restricted, conditionally restricted and/or prohibited Address feasibility of converting gravity-fed sewer systems to force main systems
	Mouth of river discharges to sound	<ul style="list-style-type: none"> Establish water quality monitoring stations at the mouth of all river discharges into the Mississippi Sound to evaluate potential pollutants Identify those inflows with gauging stations and continuous monitoring stations and use this information to assess water quality
	MS4 permitted entities <ul style="list-style-type: none"> Cross connections Illicit discharges 	<ul style="list-style-type: none"> Require inspections Adopt model ordinance Identify clear enforceable actions Identify clear line of communication Prepare handouts or develop stakeholder engagement campaign

Impaired Water Quality Matrix		
Contributing Factors	Root Causes	Solutions to Explore
Vessel discharges	Onboard wastewater	<ul style="list-style-type: none"> Evaluate current laws that address onboard wastewater discharges Identify problem areas of onboard wastewater discharges (fish camps) Engage USCG to monitor/enforce laws Explore CWA Section 312 that allows states to designate waters as "no-discharge zone" for vessel sewage discharges especially in sensitive shellfish areas Explore mandatory marine sanitation devices on all vessels of a certain length or greater Encourage the resilient marina program Develop stakeholder engagement campaign
	Fuel spills Cargo spills	<ul style="list-style-type: none"> Educate and engage the public to report fuel/cargo spills and environmental incidents to the National Response Center 1-800-424-8802
Ocean acidification		



Appendix V

Limited Suitable Substrate Matrix		
Contributing Factors	Root Causes	Solutions to Explore
Lack of data regarding resource quantity, location, and delineation	Lack of sufficient benthic habitat mapping Insufficient planning for reef expansions	<ul style="list-style-type: none"> • Develop, fund and implement comprehensive habitat mapping plan • Take stepwise approach for localized to coast wide habitat mapping • Start mapping historical reef areas and expand outward to delineate bottom characteristics • Create substrate suitability maps using HSI informed by surveys • Determine substrate type/mixture via penetrometer • Analyze sediment core • Include depositional rates for sediment source
Change in substrate over time affecting suitability for oyster production	Sediment contamination Sediment accretion Sediment scouring	<ul style="list-style-type: none"> • Routine or event-specific habitat mapping and accompanying sediment sampling to characterize geochemical properties • Deploy scouring plates on legacy reefs (and new cultch) to assess intensity of sloughing/scouring; relate to experimentation of spat settlement in flume tanks • Analysis of suspended sediment/detritus vs. spat settlement rates in legacy reef and cultch areas; include periodic toxicity assessments
Substrate removal and disturbance	Harvesting Dredging Shrimping	<ul style="list-style-type: none"> • Consider adoption of Shell Budget Model or other no-net change model to better manage annual harvest • Develop shell recycling program • Develop/update substrate management plan to maximize retention of shell resources • Assess direct/indirect effects of sediment contamination, accretion and scouring on water quality • Manage dredging and shrimping practices which affect sediment disturbances • Provide incentives to oyster processors to preserve shell for cultch material and to return live sub-market sized oysters to the reef
Improper and inefficient reef restoration methods	Use of ineffective substrate material Lack of availability of effective materials Inadequate cost/benefit analysis	<ul style="list-style-type: none"> • Evaluate/review literature and conduct field-based experiments to determine optimum cultch material for various bay systems • Fund cost-benefit analysis for available cultch types • Create shell retention/return requirements • Assess reef material • Explore alternate reef-building materials
Ocean acidification Hypoxia		<ul style="list-style-type: none"> • Develop/implement monitoring program • Review current literature and develop BMPs for handling future events



Appendix VI

Existence of Negative Non-Environmental Factors		
Contributing Factors	Root Causes	Solutions to Explore
User conflicts <ul style="list-style-type: none"> • Homeowners • Recreational boaters • Commercial fishermen • Pipelines • Navigation channels • Federal, State, Local entities and uses 	Negative perception by homeowners that oyster resource/activities diminish <ul style="list-style-type: none"> • Aesthetic values • Tourism • Economic opportunities Commerce demands <ul style="list-style-type: none"> • Navigation • Pipelines Economic development Increased populations in coastal zones Limited resources or geographic constraints on habitat <ul style="list-style-type: none"> • Shrimping grounds • Recreational fishing areas Unintended conflicts such as municipal needs over resource needs	<ul style="list-style-type: none"> • Education and outreach • Community planning and stakeholder inclusion • Zoning regulations to deal with runoff, storm water (retention and detention ponds), and materials • Build a reef as an outreach project such as nonproduction reef projects or living shoreline <ul style="list-style-type: none"> ◦ Citizen ◦ Scientists ◦ Schools ◦ Civic groups • Simplify permitting process for neighborhood reefs and fishing structures • Suitability mapping to insure the resources are being utilized in a fair, equitable, and sustainable manner
Use of improper equipment and harvesting gear	Improper use of gear <ul style="list-style-type: none"> • Dredge flipping • Basket versus bag • Weight • Line scope Lack of research on improved methods or impact to the resource Gear preferences	<ul style="list-style-type: none"> • Education and outreach for oyster fishermen • Research on gear impacts and research to improve gear technology/efficiency

Existence of Negative Non-Environmental Factors

Contributing Factors	Root Causes	Solutions to Explore
Local and regional conflicts Political interests	Limited resources <ul style="list-style-type: none"> Partitioning resources Geographic resources Perception or attitudes Lack of cohesive planning for the entire Gulf Coast, continued turf and political boundaries remain challenging Regionalism (Pine Belt, Delta, vs. Coastal needs and desires) Priorities other than for natural resources	<ul style="list-style-type: none"> Education and outreach Community Projects (Adopt a Reef, shell recovery, etc.) Develop political will and advocacy
Regulatory challenges	Often disputed, multi-level regulations	<ul style="list-style-type: none"> Streamline regulatory process and procedures
Poor management decisions	Industry pressure Resource closures Conflicting regional interests	<ul style="list-style-type: none"> Educate about value beyond fishery Move to stock assessment process for resource Education of larger picture for region as a whole
Lack of environmental regulatory enforcement	State agencies' lack of enforcement Regulations may not have consequences to force compliance Perception of accountability <ul style="list-style-type: none"> See oil slick, don't see dead shell 	<ul style="list-style-type: none"> Education followed by consequence (increasing consequence) to violators Enforce zoning regulations for point and non-point source pollution
Lack of public awareness	Loss of connectivity to resource	<ul style="list-style-type: none"> Stewardship projects <ul style="list-style-type: none"> Living shoreline Shell recovery projects Education and outreach <ul style="list-style-type: none"> PSAs Schools Scouts Coastal history
Lack of funding	Lack of prioritization for natural resources <ul style="list-style-type: none"> Roundabouts versus reefs "Front end" of water supply more important than the "Back end" No connectivity to environment Regionalism	<ul style="list-style-type: none"> Integrate resource stewardship into existing/future municipal projects (roads, storm water, etc.) Mitigation options



Appendix VII

Two Comparisons Showing the Volume of Shell Removed from a Reef to the Replacement Cost of Cultch							
Example #1 - 100,000 Sacks Harvested in a given year with current Shell Retention Fee							
	Estimated Cost per Cu Yard of Cultch	Amount of Cultch (in cu yards)	Estimated Cost to Replace Lost Cultch Material	Shell Retention Fee per Sack	Shell Retention Collection	Retention Fee Collected could Deploy (cu yards)	Gap in Replacement Cost to Fee
Limestone	\$40	6667	\$266,667	\$ 0.30	\$ 30,000	750	\$236,667
Shell	\$55	6667	\$366,667	\$ 0.30	\$ 30,000	545	\$336,667
Example #2 - 100,000 Sacks Harvested in a given year with Shell Retention Fee of \$1.00							
	Estimated Cost per Cu Yard of Cultch	Amount of Cultch (in cu yards)	Estimated Cost to Replace Lost Cultch Material	Shell Retention Fee per Sack	Shell Retention Collection	Retention Fee Collected could Deploy (cu yards)	Gap in Replacement Cost to Fee
Limestone	\$40	6667	\$266,667	\$ 1.00	\$ 100,000	2500	\$166,667
Shell	\$55	6667	\$366,667	\$ 1.00	\$ 100,000	1818	\$266,667





