



MISSISSIPPI DEPARTMENT OF MARINE RESOURCES OYSTER RESTORATION AND RECOVERY PLAN

Mississippi Department of Marine Resources

Purpose

This document aims to state the current status of the commercial oyster industry in coastal Mississippi while simultaneously casting our vision to the future and where we, as a department, want to take the oyster industry.

Mississippi Department of Marine Resources Mission Statement

The Mississippi Department of Marine Resources (MDMR) is dedicated to enhancing, protecting and conserving marine interests of the state by managing all marine life, public trust wetlands, adjacent uplands and waterfront areas to provide optimal commercial, recreational, educational and economic uses of these resources consistent with environmental concerns and social changes.

The MDMR holds an important role in administering state and federal rules, regulations and mandates such as Mississippi Seafood Laws, the Mississippi Coastal Wetlands Protection Act, the Public Trust Tidelands Act, the Boat and Water Safety Act, the Derelict Vessel Act, the Non-Point Source Pollution Act, the Magnuson Act, the Wallop-Breaux Sportfish Restoration Act and Marine Litter Act.

Background

The Mississippi coastal environment encompasses an extensive, integrated array of ecosystems, habitats and natural resources, which provide both recreational and commercial opportunities for residents and visitors. Mississippi's coastal and marine environment extends from the intertidal to oceanic zones including estuaries, coastal streams, rivers, 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 all influence the development and success of oyster resources. These habitats exist as the cultural fabric connecting the Mississippi Gulf Coast - economically, environmentally and socially. The conservation and enhancement of the coastal environment are necessary to preserve the way of life in coastal Mississippi as the abundant water resources and the natural ecological systems connected by them, virtually underpin all facets of life on the Gulf Coast.

The Mississippi Gulf Coast has historically been home to some of the nation's most productive and valuable oyster resources. The Eastern oyster, *Crassostrea virginica*, is one of the most valuable aquatic resources in United States waters and subsequently, the Mississippi Gulf Coast. Over the past 100 years, the oyster resource of the Gulf Coast has sustained a growing economy and contributed greatly to the culture and heritage that defines Mississippi coastal natives. The oyster industry has been a source of livelihood for many generations of fishermen living on the Gulf Coast. To this day, many families continue to depend on Mississippi coastal waters and the rich, natural resources found among them.

Eastern oysters are naturally found in clump-like structures that form reef habitats in shallow, semi-enclosed estuaries along coastlines. They are capable of withstanding fluctuations in both temperature and salinity found in nearshore habitats. These reef habitats offer refuge for crucial prey fish and invertebrates, leading to higher species abundance compared to adjacent mudflats. Oyster reefs can control phytoplankton populations through water filtration, helping mitigate eutrophication. They also provide ample protection to adjacent shorelines from erosion. The historic maximum acreage of the Mississippi public oyster reefs is estimated at 12,000 acres. In 2004, 491,000 sacks of oysters were harvested from Mississippi waters. Over the past decade, Mississippi's natural oyster resource has declined greatly due to several natural and man-made disasters such as Hurricane Katrina, the *Deepwater Horizon* oil disaster and multiple Bonnet Carré

Spillway openings. The decline in the oyster population across the Mississippi Sound has been devastating for many and continues to threaten the culture and heritage of oyster harvesting that once thrived in Mississippi. Without intervention, this resource may disappear from Mississippi coastal waters.

Despite the outlook for current and future oyster seasons, Mississippi is positioned to become a Gulf of Mexico leader in oyster production. To get there, the State must develop, implement and abide by a plan that incorporates current best practices and technologies for production, management and conservation. By doing so, the State will reach its goals of increasing oyster harvest and creating new jobs and business opportunities while improving the environment through species recovery, habitat creation and cleaner water.

Over the years, a tremendous amount of effort and funding has been put towards restoration efforts to improve Mississippi's oyster resources. The MDMR is participating in multiple projects that improve and expand public reefs, promote aquaculture-based farming, restore living shorelines, promote new oyster growth and help advance remote setting facilities and hatcheries along the Mississippi Sound. This document will summarize these projects and will identify how each project will benefit the resource or environment.

Goals and Objectives

The MDMR Marine Fisheries Shellfish Bureau has many goals and objectives to aid in the restoration and recovery of the native Mississippi oyster population. These include working to increase oyster density on the public oyster reefs, expanding oyster reef resilience through habitat improvements, developing and increasing the footprint of spawning oyster reefs, enhancing and expanding oyster aquaculture and improving water quality through wastewater treatment enhancements. Projects to address these goals and objectives are separated into three categories: 1) active projects, 2) future funded projects and 3) future unfunded projects.

I. Management and Recovery Initiatives

Active Projects

| | <u>Project Title</u> | <u>Total Award</u> | <u>MDMR Award</u> | <u>Page</u> |
|----|--|--------------------|-------------------|-------------|
| A. | Mississippi Oyster Cultch Restoration | \$11,000,000 | \$390,684 | 5 |
| B. | Oyster Restoration and Management Phase I | \$11,780,000 | \$658,437 | 5 |
| C. | Oyster Reef Restoration | \$125,000 | \$125,000 | 6 |
| D. | Restore Off-Bottom Oyster Aquaculture Program | \$1,055,121 | \$881,292 | 7 |
| E. | Remote Oyster Setting Facility Project – Phase I | \$9,360,000 | \$1,065,902 | 8 |
| F. | Shellfish Sanitation Compliance Program | \$200,000 | \$200,000 | 9 |
| G. | Tidelands Off-Bottom Oyster Aquaculture Program | \$120,000 | \$120,000 | 10 |
| H. | Oyster Restoration Aquaculture Program | \$150,000 | \$150,000 | 10 |
| I. | Shellfish Water Quality Testing Laboratory | \$760,000 | \$760,000 | 11 |
| J. | Oyster Cultch Planting Program | \$1,000,000 | \$1,000,000 | 12 |
| K. | Oyster Plant – Spat-Tech | \$3,000,000 | \$3,000,000 | 12 |
| L. | Recruitment and Settlement Patterns of Oyster Spat | \$19,374 | \$19,374 | 13 |
| M. | Enhancement of the St. Louis Bay TNC Oyster Reef | \$3,166,162 | \$0 | 13 |
| N. | Oyster Shell Recycling Program | \$650,000 | \$0 | 14 |
| O. | Permitting for the Expansion of Oyster Resources | \$0 | \$0 | 14 |
| P. | Pascagoula Oyster Reef Complex Relay and Enhancement | \$4,100,000 | TBD | 16 |
| Q. | USM Hatchery and Research Center | \$8,827,885 | \$0 | 16 |
| | Total: | \$55,313,542 | \$8,370,689 | |
| | | | | |

A. Mississippi Oyster Cultch Restoration

The *Mississippi Oyster Cultch Restoration* project was funded through the Natural Resource Damage Assessment (NRDA) Program. The focus of this project was to restore and enhance existing oyster reefs with cultch in Mississippi waters that were injured by the *Deepwater Horizon* oil disaster. This project has enhanced approximately 1,430 acres of the oyster cultch areas that cover approximately 12,000 acres of the Mississippi Sound. A total of 143,000 cubic yards of cultch material was deployed at a rate of approximately 100 cubic yards per acre. Construction began in September 2012 and was completed in 2014, and biological monitoring was performed from 2014 through 2020.

Side-scan sonar was utilized to identify potential cultch placement areas, as well as monitor cultch placements post-deployment. Side-scan sonar was also used for the physical monitoring of reefs because of the ability to rapidly cover large areas and provide accurate measurements of coverage while simultaneously providing accurate GPS coordinates. Information acquired from the side-scan sonar provided a permanent record that will be used to detect changes over time due to environmental catastrophe, vessel groundings and reef shifts.

B. NFWF / MDEQ - Oyster Restoration and Management Phase I

In 2016, the National Fish & Wildlife Foundation Gulf Environmental Benefit Fund (NFWF GEBF) funded the Oyster Restoration and Management (MS)-Phase I project led by the Mississippi Department of Environmental Quality (MDEQ) and in coordination with the MDMR. This project seeks to improve oyster populations and sustainability in coastal Mississippi by conducting studies to better understand oyster resiliency, how oyster productivity can be improved and provide managers with information needed to improve the cost-effectiveness and sustainability of future large-scale restoration projects. One of the studies within the broader projects was to evaluate cultch efficacy for spat recruitment as well as oyster survival, the experiment will consider two variables: 1) cultch material size limestone and 2) relief (high vs. low undulations of the deployed cultch).

The project, three 10-acre plots in Biloxi Bay, will analyze the material type and relief with a maximum relief of cultch up to 16 inches in elevation above the substrate (average coverage of 8

inches) to discern differences in oyster recruitment and productivity. Exact relief will be determined following cultch deployment from SWATH bathymetry and field sampling. Findings will identify gaps in restoration data and emphasize the need for more robust monitoring and goal setting for future projects.

C. MDMR Tidelands Trust Fund – Oyster Reef Restoration

The primary goal of the Oyster Reef Restoration Project is to restore and create oyster reefs within the vicinity of Biloxi Bay along with its bays, bayous and tributaries where conditions are suitable for oyster growth and sustainability. The secondary goal is to identify the most effective and efficient cultch materials available to resource managers for oyster restoration.

Staff will assess the suitability of specific areas within the proposed project location to identify potential restoration sites. Funds from this project will be used to acquire cultch materials, primarily oyster shell, which is in very limited supply, to accomplish the main restoration goal of this project. Staff will utilize the RV Conservationist and the Artificial Reef Bureau staging site, located on the Industrial Seaway in Gulfport, to load and deploy different cultch types (oyster shell, limestone, crushed concrete, etc.) for the purpose of oyster reef restoration. Other innovative methods, such as the deployment of oyster bags, remote setting of spat on cultch, use of engineered domes, etc. may be considered where feasible. Once the material has been deployed for restoration, those sites will become part of the MDMR's annual Oyster Reef Assessment, and each site will be evaluated over time to monitor oyster growth, health and performance of different cultch types as it relates to oyster restoration.

The primary objective of this project is to restore, create and increase the area of public oyster reefs in the eastern Mississippi Sound. Secondary objectives are to test different cultch types and methods of restoration to determine the most effective and efficient available options for resource managers to increase oyster production, and to support those goals and strategies set forth by the Governor's Oyster Restoration and Resiliency Council for the recovery of Mississippi's public oyster resources. A total of 7,692 cubic yards of oyster shell cultch was deployed on Biloxi Bay Reef and Henderson Point Reef.

D. RESTORE Act / MDEQ - Off-Bottom Oyster Aquaculture Program

Over the last decade, the decreased density of harvestable oysters has limited the number of oystermen engaged in the oyster industry along the Mississippi Sound. Diversifying the oyster industry by training oystermen and fishermen in off-bottom aquaculture was a direct objective of the Governor's Oyster Council Restoration and Resiliency report and will support and grow the oyster industry and the overall Mississippi economy. The RESTORE Act funded Off-Bottom Oyster Aquaculture Program has provided training in off-bottom oyster aquaculture operations, including business development and aquaculture methodologies, and will result in hands-on training on state-owned farms. Diversification of the oyster industry using off-bottom aquaculture techniques that use racks, cages, rafts or longlines to grow oysters has proven to be very successful for enhancing workforce development and job creation.

The Off-Bottom Oyster Aquaculture Program addresses all aspects of off-bottom oyster farming appropriate to the local and regional area in oyster aquaculture operations, including business development and aquaculture methodologies. Participants will be positioned to operate and maintain economically and environmentally sustainable off-bottom oyster farms in the state of Mississippi, increasing the quantity and value of Mississippi's annual oyster harvest. MDMR established a two-phase off-bottom oyster aquaculture program, as well as offers post-program business incubation services. Phase I of the program includes classroom and field education on aquaculture, business operations and demonstrations of off-bottom aquaculture techniques. During this phase, participants receive the training and assistance needed to deploy and manage approximately 10,000 oysters with the use of MDMR rental equipment, such as cages and bags, as well as the MDMR small and large tube tumbler. During Phase II of the program, training participants open their off-bottom oyster aquaculture operations to continue training with instruction from the program to refine skills before beginning an individual operation.

The acreage of available off-bottom leases has also increased from 2018 to 2021 in a total of three phases. Phase I included the ten-acre aquaculture training park and 75 acres available for commercial lease. In 2020, Phase II comprised of 135 additional acreages to the west of Phase I, provided commercial oyster farmers with a deep-water profile option as well as closer to the Biloxi Small Craft Harbor. In 2021, Phase III, which is also the final phase, will be available to

commercial farmers which opens an additional 245 acres. Phase III is located north of Phase I and II, giving farmers the opportunity to farm in more shallow waters closer to Deer Island. In 2021, there will be a total of 465 acres available for commercial farming. The continuation of the MDMR Off-Bottom Oyster Aquaculture Program will allow aquaculture staff to train more farmers and lease out all acreage in approximately five to 10 years.

E. RESTORE Act / MDEQ - Remote Oyster Setting Facility Project, Phase I

Remote setting is the placement of oyster larvae onto cultch at a remote location separate from the hatchery itself. This facility would assist in increasing the production of the natural oyster reefs along the Mississippi Gulf Coast. The remote setting facility is a critical component in the Governor's Oyster Council's blueprint for oyster restoration, as it will enable the MDMR to place cultch, laden with spat, at high volumes into Mississippi waters, which will support the increase of oyster populations on Mississippi's harvestable reefs and benefit the oyster fishery economy. This project will protect and restore living coastal and marine resources, promote community resilience and restore, improve and protect water resources.

The Shellfish Bureau has identified the Port of Gulfport Small Craft Harbor as the ideal location to situate the Remote Setting Oyster Facility. This location was selected for logistic efficiencies of cultch transportation into and out of the setting facility, the site's capacity to support the facility, optimal water quality conditions including salinity regimes and an existing relationship with the Port of Gulfport for a pilot setting facility in the same location.

The staff has interviewed, selected and contracted a private engineering firm to complete Phase I of the Remote Setting Facility Project. During Phase I, planning activities will be undertaken to assess the overall feasibility of the facility and determine infrastructure layout, as well as ongoing operational and maintenance costs. Phase I will produce a facility design that will have the capacity to receive 2.5 billion eyed larvae per year for remote setting with productive use of space and acceptable culture methods to achieve optimal setting efficiencies and production milestones. The facility plans will also include an itemized list of equipment and supplies, staffing requirements for production and projections of annual operational costs.

There are also many other design expectations that are part of Phase I other than the culture system. It will also involve the design of ergonomic ways to transport, load and unload large quantities of cultch material and spat on shell. Also, it will include a design for a robust pier to accommodate the docking and movement of cultch material on and off vessels.

Phase I is expected to be completed by March 2022, and if the results of Phase I are satisfactory, Phase II construction and start-up operations will begin immediately.

F. MDMR Tidelands Trust Fund - Shellfish Sanitation Compliance Program

Conducted within the guidelines of the Interstate Shellfish Sanitation Conference (ISSC) National Shellfish Sanitation Program (NSSP) Model Ordinance document, the Shellfish Sanitation Compliance Program determines the health of oysters by evaluating the quality of waters surrounding oyster reefs within the Mississippi Sound. Routine bacteriological samples ensure the sanitary control and safety of all oysters harvested for human consumption by commercial and recreational fishermen, the seafood industry, restaurants and tourism. Illness associated with human consumption of raw or undercooked oysters stems primarily from elevated levels of bacteria from human and animal waste, called fecal coliforms, that are concentrated within oysters during the filter-feeding process. These bacteria make their way to the oyster reefs through stormwater runoff, sewage overflow, domestic and wild animal waste, wastewater treatment plant failures, etc.

In addition to public safety, routine sampling provides insurance to shellfish managers that no new pollution sources are posing a threat to harvesting, preserving and protecting oyster reefs, which are one of Mississippi's key natural resources. The MDMR Shellfish Bureau regularly uses the information gained from the Shellfish Sanitation Compliance Program to properly classify the state's oyster growing waters in varying degrees of harvest and restrict harvest when conditions become unfavorable for human consumption. The objective of this project is to analyze seawater and oyster meat samples for management decisions on proper oyster harvesting throughout the year and for the annual evaluation of shellfish growing area classification by the Food and Drug Administration (FDA).

Bacteriological samples are collected once a month for all eight of Mississippi's oyster growing water areas, especially during colder months when fecal coliforms are more present. Sample sites are located throughout the Mississippi Sound and are primarily situated between the oyster reef and any potential pollution sources. Water samples are transported by MDMR personnel to an FDA-certified laboratory where the analysis is performed. Once MDMR receives sample results, shellfish scientists analyze the data in comparison with environmental factors and historical data to correlate potential pollution sources and identify seasonal trends. In addition, the annual program evaluation completed by an FDA Shellfish Specialist uses the data collected from this program to monitor compliance of a food safety product with federally approved standards.

G. MDMR Tidelands Trust Fund - Off-Bottom Oyster Aquaculture Program

A critical component of any successful aquaculture project is the infrastructure behind the program. The MDMR has made substantial investments to install physical assets that will support the RESTORE Act, off-bottom oyster aquaculture program and will continue to support the expansion of aquaculture in state waters. MDMR staff are committed to increasing the acreage at the Deer Island Oyster Aquaculture Park to 465 acres for Public Trust Tidelands Sub-leases and there are plans to develop aquaculture parks in each coastal county. Assuming the aquaculture park reaches maximum capacity, and each farmer is producing the minimum requirement of 100,000 oysters per acre, the park could culture a minimum of 45 million oysters. In turn, the sales from 45 million oysters per year could profit upwards of \$27.9 million in revenue for commercial farmers. As of December 2020, MDMR has 48 acres leased, which is only 11 percent of available space in the Aquaculture Park.

H. MDMR Tidelands Trust Fund - Oyster Restoration Aquaculture Program

The Oyster Restoration Aquaculture Program and its associated projects will contribute to increased oyster production and provide a more sustainable environment and habitat for Mississippi oysters. The purpose of this project is to increase the capacity of the Mississippi Oyster Restoration Partnership, Inc. (MORP), which was a major recommendation of the Governor's Oyster Council. Projects and programs are to be performed by MORP in partnership with the MDMR and other agencies.

Currently, there is not a non-governmental entity to coordinate and implement related activities, projects and programs. The State of Mississippi and its oyster resource will benefit by having a non-profit coordinating partner and MORP will seek to support other entities with common goals and missions which are to increase and enhance oyster production, education, outreach and restoration in Mississippi waters. MORP will serve as a communication platform and coordinating entity for the implementation of many recommendations' activities related to oyster enhancement and restoration contained within the Governor's Oyster Council Report.

The programs associated with MORP include cultch planting, cultivation, relay, spat on shell and shell recycling. Cultch planting, cultivation and relay will include the identification of associated site(s), permitting, coordination and procurement of labor and materials, as well as oversight of the deployment and processes. There is anticipation to recruit and utilize local commercial fishermen as volunteers for cultch planting, cultivation and relay. Spat on shell development and deployment will comprise of remote setting of spat-laden cultch materials and then transported to oyster reefs, seed grounds and intertidal and subtidal areas. Finally, the shell recycling program involves outreach and identification of participants and the creation and implementation of logistical arrangements with stakeholders. This project will propose an incentive program to educate/engage local stakeholders in the food, beverage and gaming industries. In turn, this program will create a new source of shells that are currently, as well as forecast, to become scarce in supply. The shell recycling program would also include the development of a cultch loading dock or facility to help on-bottom oyster farmers move cultch from land to deployment vessels more easily. Development of this dock or facility will lead to increased safety, as well as support other oyster projects along the Mississippi coast such as the Oyster Gardening Program.

I. GOMESA Phase II / MDMR - Shellfish Water Quality Testing Laboratory

The MDMR Shellfish Bureau was awarded a grant to build an FDA-certified laboratory for continuous monitoring of the presence of fecal coliform indicator organisms in shellfish growing waters. The new laboratory is expected to be operational in the summer of 2022. Having an FDA-certified laboratory allows the state to be self-sufficient and cost-effective. Outsourcing a critical component, such as fecal coliform water analysis, is not cost-efficient. On average, the Shellfish Bureau collects roughly 1,000 water samples annually from water sample stations.

These samples are also used to classify the state’s oyster growing waters in varying degrees of harvest and restrict harvest when conditions become unfavorable for human consumption.

Per the NSSP Model Ordinance, the state authority must ensure that all samples are collected, maintained, transported and analyzed in a manner to assure the validity of analytical results in an FDA-certified laboratory. Currently, the Shellfish Bureau completes all components of this requirement, except for the laboratory analysis. This laboratory will allow for in-house analysis ensuring all requirements are met by MDMR staff. All data collected by an uncertified laboratory would be null and not accepted for use by the NSSP. Other uses for this project include the purchase of equipment and supplies for seawater analysis. Eventually, the state will expand on laboratory capabilities into other areas of marine monitoring. Funding for this project was awarded from the Gulf of Mexico Energy Security Act (GOMESA).

J. GOMESA Phase II / MDMR - Oyster Cultch Planting Program

The Oyster Cultch Planting Program restores and enhances oyster reefs through the placement of cultch materials, such as crushed concrete, limestone and/or cleaned oyster shells, in prime oyster habitats and other innovative oyster restoration and enhancement techniques. Cultch replacement and replenishment is a critical component of sustaining healthy oyster populations in Mississippi, especially given the recent environmental disasters that have impacted oyster resources in the state. The Shellfish Bureau will implement oyster restoration and enhancement projects on several thousand acres of suitable oyster habitat located in the Mississippi Sound.

K. GOMESA Phase II / MDMR - Oyster Plant - Spat-Tech

The primary goal of the development of an oyster plant is to deploy live oysters onto public reefs, resulting in the acceleration of oyster growth and harvesting. The oyster hatchery will use high-density oyster spat-on-shell technology that will introduce a large number of healthy oysters into the Mississippi Sound. The hatchery will be responsible for setting and growing oyster spat to a seed size of $\frac{3}{8}$ to $\frac{5}{8}$ inch average length, totaling 60 million live seed oysters.

L. NOAA / MDMR - Recruitment & Settlement Patterns of Oyster Spat

Peak oyster spawning, typically occurring in the fall after a drop in water temperature, produces free-swimming larvae that attach to a hard material on the seafloor. These attached larvae are called spat and, over time, will grow to a harvestable size. To continue to fully replenish the state's reefs, there must be a better understanding of the spawning cycle of oysters throughout the year. Little is known about the spawning and settlement patterns of oysters during periods not considered "peak" spawning season. There is evidence from recent sampling efforts that would indicate spat settlement is occurring in certain regions of the Mississippi Sound during the non-peak seasons.

Beginning in October 2020, Shellfish Bureau staff pinpointed multiple sites across the Mississippi Sound that historically showed high numbers of spat settlement and recruitment. These sites are located on reefs next to St. Louis Bay, Biloxi Bay and Pascagoula Bay. Settlement plates deployed in these locations were used to document spatial-temporal variation in spat settlement throughout 2021. Every four weeks, staff retrieved old plates, counted all spat present and deployed new settlement plates. This process was repeated until the end of December 2021.

Determining localized oyster spawning trends will give the Shellfish Bureau insight into the prime locations and months to build and replenish the necessary reefs in the Mississippi Sound. The findings of this project will improve the effectiveness of oyster restoration on the Gulf Coast.

M. MDEQ / NFWF - Enhancement of the St. Louis Bay TNC Oyster Reef

The Nature Conservancy will conduct an enhancement project on an existing oyster reef in St. Louis Bay, Miss., and expand the reef by 20 acres. Restoration will be accomplished through the deployment of cultch material at an existing 10-acre oyster reef site to add acreage and increase vertical relief. The vertical relief will ensure greater resilience to occasional incidents of low dissolved oxygen, as well as enhance habitat for other valuable fisheries. Commercial harvest in this part of St. Louis Bay is prohibited, leaving the reef available to produce spat and potentially

support the rebuilding of other nearby oyster reefs. Planning for this project began in 2020 and construction is expected to begin in 2022.

N. MDEQ / RESTORE Act - Oyster Shell Recycling Program

The Oyster Shell Recycling Program will support the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches and coastal wetlands of the Gulf Coast Region through the collection and utilization of discarded oyster shells for oyster cultch placement in the Mississippi Sound. Additionally, this program will include an economic sustainability analysis.

Shell recycling programs have been implemented throughout the coastal United States to reuse discarded oyster shells from restaurants, festivals and other venues. The program's objective is to avoid discarding oyster shells by collecting them from these venues and reusing them as cultch material for oyster reefs in the future. However, all oyster shell recycling programs from Maryland to Louisiana must consider mechanisms to ensure that the program can be sustainable after an initial start-up period. Thus, it is imperative to conduct an economic sustainability analysis that will determine the potential number of shells available for re-use across the spectrum of sources in the area, evaluate costs of hauling, storing and deploying shell, and inform the economics of the program for viability and sustainability. While the MDMR is not directly associated with the program, we support the efforts and will assist with identifying oyster reefs that will benefit from the project.

O. Permitting for the Expansion of Oyster Resources

The Shellfish Bureau has many priorities, but stock enhancement and commercial production are core to our mission. We feel that the restoration of Mississippi reefs is vital to the success of the industry, and we encourage using water bottoms for public/private reef enhancement, identifying and developing new off-bottom aquaculture areas and studying the best-emerging technologies to implement programs for economic and environmental purposes.

In 2015, MDMR applied to restore historic oyster resources across the Mississippi Sound within State of Mississippi waters, specifically in the western Mississippi Sound. Final authorization

was completed in 2017 after a thorough review process. The purpose of that project was to restore the valuable public oyster resources for the benefit of the stakeholders of the State of Mississippi and to enhance the marine environment along the Mississippi Gulf Coast. Implementation of Phase I of that project began immediately and, to date, approximately 880 acres of oyster reef have benefited from oyster restoration activities and had begun the process of recovery.

This remains the focus of this proposed project. However, since the process for the last permit began, the Federally operated Bonnet Carré Spillway has been opened multiple times by the United States Army Corps of Engineers (USACE) causing significant loss to the marine resources of the Mississippi Gulf Coast, especially oysters in the western Mississippi Sound. Because the majority of the historic oyster reefs that are part of the existing permit are located in the western Mississippi Sound and directly in the path of the waters released through the Bonnet Carré Spillway (BCS), state resource managers believe there is too much uncertainty surrounding the sustainability and viability of maintaining healthy oyster populations in this region of the Mississippi Sound to continue to invest heavily in restoration efforts and, instead, have decided to shift focus to areas further east. For this reason, it appears the more viable resource management option is to restore historic areas and expand oyster resources in Harrison and Jackson Counties, which is much further from the direct impacts caused by the frequent opening of the BCS.

This project will identify and apply with USACE and MDMR to restore and create approximately 2,524 acres of oyster reef in Biloxi Bay and expand the current footprint of the MDMR Commercial Aquaculture Parks to Harrison and Jackson counties. Restoration and creation of oyster reefs will improve water quality within the areas of the reefs, create valuable nearshore reef habitat that will support and sustain healthy populations of estuarine fish and other invertebrates and enhance recently completed and future proposed restoration areas on the eastern end of Deer Island in Harrison County, Miss., and along the Mississippi Gulf Coast.

P. MDEQ / RESTORE Act - Pascagoula Oyster Reef Complex Relay and Enhancement

The Pascagoula Oyster Reef Complex Relay and Enhancement Project will support the restoration and protection of Mississippi’s coastal resources by relaying oysters from the Pascagoula Oyster Reef Complex (PORC) to harvestable areas and enhancing the PORC. The oyster restoration and management project may include benthic habitat mapping, reef monitoring, cultch planting and the relay of oyster resources to increase productivity on harvestable reefs.

Oyster restoration and management are critical to enhancing ecosystem functionality and the integrity of bays and estuaries within the Mississippi Sound. This proposed project will restore, enhance and replenish oyster populations on the PORC through increased understanding of oyster reef habitat acreage and volume, creating a scientifically based oyster relay program to maximize sustainable oyster production, increase available acreage and volume for larvae settlement and monitoring production on the reef throughout time to adjust relay program targets for sustainable take and production.

Initial assessment and annual monitoring of existing PORC will create estimates of the number of oysters by size class and allow annual projections of oyster sacks to be moved through the oyster relay program. The PORC relay program will maximize the sustainable harvest (through monitoring data) and the transfer of harvestable size class oysters from the PORC to open harvest-growing waters in the Mississippi Sound.

Q. MDEQ / RESTORE Act - USM Oyster Hatchery and Research Center

This project will provide the additional infrastructure that will benefit the ecological resources of the Gulf Coast Region by supporting the University of Southern Mississippi (USM) with the development of an oyster hatchery and research center located at USM’s Gulf Coast Research Laboratory (GCRL) at Cedar Point in Ocean Springs, Miss. In Mississippi and throughout the Gulf of Mexico, the oyster industry serves as an integral part of the ecology and economy of coastal communities.

Events over the past decade, such as Hurricane Katrina, the Deepwater Horizon oil disaster and multiple BCS openings, have impacted oyster resources in Mississippi and caused significant reductions in oyster landings. The State of Mississippi, through the Governor’s Oyster Restoration and Resiliency Council, has prioritized oyster aquaculture as a key component for the restoration of regional oyster stocks for economic and ecological restoration. To elevate oyster stocks to the goals set forth by the Governor’s Oyster Restoration and Resiliency Council, the investment in an oyster hatchery will benefit the recovery of oyster production and landings in the Mississippi Gulf Coast Region.

The facility will further be supported by the ability to research oyster husbandry and rearing techniques, thereby supporting anticipated incremental advances in oyster larvae production. Realized advances would allow for a sustainable supply of seed, which could be used for replenishment of harvest reefs. Seed could also be used in non-harvestable areas for water quality improvement, to create habitat, enhance recreational fishing and support shoreline stabilization efforts. The facility will employ artificial seawater systems and recirculating aquaculture systems to produce oyster larvae to support state restoration activities. The utilization of recirculating artificial seawater provides for sustainable production and controllable water quality to allow for optimum survival and growth of oyster larvae. Anticipated research would also include the development of improved feed (algal) stocks, disease-resistant strains and triploid oysters.

II. Management and Recovery Initiatives

Future Funded Projects

| | <u>Project Title</u> | <u>Project Award</u> | <u>Page</u> |
|----|--|----------------------|-------------|
| A. | Oyster Spawning Reefs in the Mississippi Sound | \$10,000,000 | 18 |
| B. | Remote Oyster Setting Facility Project – Phase II | \$7,700,000 | 19 |
| C. | Restoration of Mississippi’s Oyster Reefs | \$5,000,000 | 20 |
| D. | Expansion and Enhancement of Oyster Aquaculture in Mississippi | \$1,566,380 | 20 |
| E. | Investigation of Pollution within Shellfish Growing Waters | \$287,650 | 21 |
| F. | Development of a Shellfish Harvester Training Video | \$75,000 | 22 |
| G. | Off-Bottom Oyster Aquaculture Program | \$1,457,395 | 23 |
| | Total: | \$26,086,425 | |

A. MDEQ / NRDA - Oyster Spawning Reefs in the Mississippi Sound

The Oyster Spawning Reefs in Mississippi Project will result in the creation or restoration of high-relief cultch placements within the Mississippi Sound and areas including St. Louis Bay, Heron Bay, Back Bay/Biloxi Bay, Graveline Bay, Pascagoula Bay and Grand Bay located in Hancock, Harrison and Jackson Counties. Oyster restoration will include a minimum of 100 acres and a maximum of 400 acres of subtidal reefs. Creation and restoration of the reefs will include siting reefs, design and cultch deployment. No more than 35% of the cultch will be placed in harvestable (tonging only) zones with the remaining cultch placement in restricted and prohibited areas. These actions will help restore Mississippi oyster habitats injured during the *Deepwater Horizon* oil disaster. The anticipated timeframe for oyster restoration activities, including monitoring, will be 10 years.

B. MDEQ/RESTORE Act - Remote Oyster Setting Facility Project – Phase II

After Phase I, Remote Setting Facility planning, the budget and scope for startup costs will have been developed and will then enter Phase II, Construction and Start-Up Operations. Phase II will aim for the construction of the remote setting facility and procurement of necessary equipment and will be based on the planning activities, engineering and design specifications developed in Phase I.

The purpose of the Remote Setting Facility Project is to support the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches and coastal wetlands of the Mississippi Gulf Coast Region through the planning, construction and operational activities associated with a Remote Setting Facility Project. This project will protect and restore living coastal and marine resources, promote community resilience and restore, improve and protect water resources. The remote oyster setting facility would be complementary to the USM Oyster Hatchery. Larvae produced within the USM Oyster Hatchery would be transported to the Remote Setting Facility Project and placed on cultch materials.

The expectation for this facility will be to receive 2.5 billion oyster larvae from USM to set on shell and eventually be planted on local reefs within the Mississippi Sound from May through November. Production and setting efficiencies will be optimized using the best available science and scientific expertise and testing. MDMR estimation, based on the historical setting efficiency at the Gulfport location, is 15 percent. Therefore, 750 million spat will be set on approximately 52 million individual shells each year of production for the Remote Setting Facility Project.

The spat on shell produced at the facility will be deployed at oyster growing sites deemed appropriate by the MDMR Shellfish Bureau. The short-term benefits of this project will include an immediate increase in oyster abundance and the reproductive potential in specific areas. Long-term benefits will include an increase in oyster productivity, resilience and stabilization of reef locations for future harvesting.

C. Bonnet Carré 2019 Fisheries Disaster Recovery Program – Restoration of Mississippi Oyster Reefs

This project will provide for the restoration of existing oyster reefs, as well as the creation of new oyster reefs, in the Mississippi Sound. The deployment of approved oyster cultch material will take place over five years on suitable water bottoms in the three coastal counties with the majority of the effort in the Western Mississippi Sound where the most recent assessment indicates the need is greatest. This cultch planting project is estimated to cover as many acres of water bottoms with cultch material (limestone, crushed concrete and oyster shell) as needed for a successful oyster spat set. Cultch planting rates and material types may be adjusted to maximize benefits specific for each area. Cultch planting may also be conducted in areas with historically high spat sets but lower long-term survival (e.g., high salinity areas), to move or relay juvenile oysters into areas with higher growth and survival rates (e.g., moderate salinity areas).

D. Bonnet Carré 2019 Fisheries Disaster Recovery Program – Expansion and Enhancement of Oyster Aquaculture in Mississippi

The oyster industry in the Mississippi Sound is currently limited to a small number of off-bottom leaseholders and public harvestable reefs. Decreased density of harvestable oysters has limited the number of oystermen engaged in this economic sector. Diversification of the oyster industry using off-bottom aquaculture techniques such as racks, cages, rafts or longlines to grow oysters has proven very successful for enhancing workforce development and job creation in Mississippi and other Gulf states. Currently, there are two main challenges for the oyster farming industry: 1) a need to scale up farm operations and 2) a need to increase productivity and reduce labor costs. This program will spend significant time identifying, troubleshooting and solving these issues for Mississippi oyster farmers. This project will develop solutions unique to the local area and geographic limitations and will focus on the two previously mentioned aspects of the growing industry using new technologies to identify methods that streamline cultivation activities, increase distribution and, ultimately, expand the off-bottom oyster industry.

This project will also establish a grant and/or loan program to incentivize stakeholders to participate in off-bottom oyster aquaculture. Funds distributed to stakeholders could be used to

purchase equipment, cultch materials or assist in the permitting process which would incentivize more participation and long-term private investment in off-bottom oyster aquaculture. This program would provide affordable financing to fishermen and other parties who want to start or expand commercial shellfish aquaculture operations in Mississippi.

E. Bonnet Carré 2019 Fisheries Disaster Recovery Program – Investigation of Pollution within Shellfish Growing Waters

Many waterbodies across the Mississippi Sound, suitable for growing wild and aquaculture oysters, are currently classified as restricted or prohibited for oyster harvest due to poor water quality conditions. These poor conditions are often related to high fecal coliform load. An increase in fecal coliform levels found in marine environments may be an indication of contamination from wastewater or sewage. This bacterium usually enters waterways by the discharge of human sewage directly into a waterbody; failing wastewater infrastructure or home septic systems; an increase in waste from mammals and birds; agricultural practices such as livestock grazing near waterways, or using manure as fertilizer; runoff from storm drains, parking lots or yards which carry pet waste to nearby streams and tributaries; etc.

Our staff has identified locations across the Mississippi Sound that currently are unsuitable for reclassification due to poor water quality conditions. The purpose of these investigations is to locate the source of historically high fecal coliform levels within several smaller, nearshore water bodies across Mississippi’s coastline. By homing in on smaller water outlets, staff can work to pinpoint the source(s) of pollution contributing to localized poor water quality. Once these sources are identified, staff will work with local municipalities to develop strategies for mitigation and decrease fecal loads. When water quality improves, several areas can be reclassified across the Mississippi Sound enabling the MDMR to expand and grow the on-bottom and off-bottom oyster industry. In addition, this effort will improve water quality conditions and remove the human contribution of contamination. The chosen areas will be evaluated before the field investigation. Staff will compare historical fecal coliform data with river stages, rainfall levels, tides, current patterns, wind direction and velocity and seasons to determine if there are any environmental correlations.

Field investigations will consist of two parts. First, staff will visit city administrations to discuss the wastewater infrastructure near the area of concern, locate all lift stations and wastewater treatment centers and drive the area for signs of sewage failures and infrastructure problems. Second, the sampling investigations will consist of four phases throughout the year in which staff will correlate sample times with tides and weather. To ensure rainfall does not influence the sample results, the sampling regime will be conducted during dry conditions. Samples will be collected periodically through a 12-hour tidal cycle. Along with each phase of the investigation, a tidal current study will be conducted to show the direction of flow of water from the potential pollution source.

Once these sources are identified, staff will work with local municipalities to develop strategies to mitigate and decrease fecal loads. When water quality improves, areas can be reclassified across the Mississippi Sound allowing the MDMR Shellfish Bureau to develop additional oyster aquaculture farms for oyster harvesters. On top of increasing the economic success of Mississippi's oyster fishery, this effort will improve water quality conditions and remove the human contribution of contamination.

F. Bonnet Carré 2019 Fisheries Disaster Recovery Program – Development of a Shellfish Harvester Training Video

In 2014, the ISSC set forth the requirement that all states with shellfish harvest must offer an educational training program to oyster harvesters. The training includes shellfish sanitation requirements, safe harvesting, handling, transportation methods, etc. This program is required as a prerequisite to receiving a commercial oyster harvester license and the training certificate must be renewed every five years. The development of a training video will offer a thorough, concise and consistent training session to all oyster harvesters and will allow for remote access to the training session. In addition to the training, harvesters should receive the materials needed to complete the trip ticket and tags in the field with consideration of adverse environmental conditions.

G. GOMESA 2021 – Off-Bottom Oyster Aquaculture Program

Among the many challenges to raising oysters is discovering how they grow in specific environments. Different parts of the world use different types of gear for oyster aquaculture to contain and grow oysters depending on wind, waves, tidal fluctuation, temperature and local regulations. Finding the right gear for a particular farm could become a costly exercise in trial and error. Through this project, Shellfish Bureau staff will build a demonstration facility that will help oyster farmers test new gear and techniques in hopes of expanding the state’s oyster industry. A demonstration facility will allow farmers to test new equipment, combine resources and streamline efficiencies so oyster farmers do not have to absorb the risk alone. As oyster farmers face a diverse array of challenges, this program hopes to address those issues and have meaningful impacts to help grow the oyster aquaculture industry.

III. Management and Recovery Initiatives

Future Unfunded Projects

| | <u>Project Title</u> | <u>Project Award</u> | <u>Page</u> |
|----|--|----------------------|-------------|
| A. | Cultch Planting | \$20,000,000 | 24 |
| B. | Cultivation of Suitable Oyster Reefs | \$5,000,000 | 24 |
| C. | Assist Coastal Municipalities Upgrade Faulty Sewer Systems | \$2,000,000 | 25 |
| D. | Incentivize Diploid Production for Oyster Aquaculture | \$5,000,000 | 26 |
| E. | On-Bottom Oyster Aquaculture | \$1,000,000 | 26 |
| F. | Biloxi Bay Habitat Assessment | \$1,000,000 | 27 |
| | Total: | \$34,000,000 | |

A. Cultch Planting

Cultch planting restores and enhances oyster reefs through the placement of cultch materials, such as crushed concrete, limestone and cleaned oyster shells, in prime oyster habitats and other innovative oyster restoration and enhancement techniques. Cultch replacement and replenishment is a critical component of sustaining healthy oyster populations in Mississippi, especially given the recent environmental disasters that have impacted oyster resources in the state. The MDMR Shellfish Bureau plans to implement a large-scale oyster restoration and enhancement project with the assistance of a private contractor to provide and deploy cultch materials in several of the thousands of acres of suitable oyster habitat located in the Mississippi Sound, including historically prolific reefs such as Telegraph Reef. Upon completion, this project will restore and enhance over 300 acres of oyster habitat and produce upwards of 30 million live oysters. This project is projected to be funded through GOMESA for 20 years in the amount of \$1,000,000 per year for a total of \$20,000,000. Program requirements will be determined upon approval.

B. Cultivation of Suitable Oyster Reef

Cultivation of oyster reefs is the process of tilling non-viable reefs to expose hard substrate for spat settlement and to sufficiently clean sediment and unwanted organisms from the reef

material. This project would employ Mississippi oystermen to cultivate suitable oyster reefs using a bagless dredge. Used by many fishermen, a dredge is a tool with a strong frame holding up a chain metal bag. Attached to the lower lip of the frame are multiple metal teeth. The oystermen tow the dredge slowly behind their boat while the teeth dig into the top layer of the reef, filling the bag with the fisherman's catch. During cultivation, however, the absence of the bag means the reef material is turned over and not taken from the reef.

In 2022, results from the project titled, '*Recruitment and Settlement Patterns of Crassostrea virginica on Oyster Reefs in the Mississippi Sound,*' will be available to determine when to avoid reef cultivation for natural spat set. The results will emphasize which reefs are producing more spat and will allow staff to plan accordingly to maximize reef cultivation. Secondary beneficial purposes include breaking up clusters of oysters for a more even distribution of the reef and to help reduce hooked mussel infestations. Proposed areas of cultivation include the Eastern and Western Mississippi Sound reefs. This project is projected to be funded through GOMESA and is estimated at \$5,000,000. Program requirements will be determined upon approval.

C. Assist Coastal Municipalities with Upgrading Faulty Sewer Systems

Sanitary surveys are conducted annually by the Shellfish Bureau to pinpoint new sources of pollution to the Mississippi Sound and assess the condition of wastewater treatment plants, city sewer systems, and single home septic tanks. The final report is analyzed by an FDA Shellfish Specialist who determines the overall health risk of Mississippi-grown oysters sold to the public. The goal is to ensure a clean coastline with as little pollution as possible. Unfortunately, through these surveys, the Shellfish scientists have documented many failing lift stations, overflowing manhole covers and sewer and septic leaks into the Mississippi Sound.

These are problems that can be fixed through specific projects that aim to mitigate human waste pollution found in the oyster growing waters. The Shellfish Bureau intends to assist each municipality with direct influence on an oyster reef to find the appropriate funding to fix these commonly seen problems. A designated team will work with coastal municipalities to secure the necessary funding and see the project through to completion. This work has the potential to open currently restricted areas to harvest and pave the way in building additional oyster aquaculture

parks and replenishing historical habitats for future healthy and productive oyster reefs. This project is projected to be funded through GOMESA and is estimated at \$2,000,000. Program requirements will be determined upon approval.

D. Incentivize Diploid Production for Oyster Aquaculture

Most off-bottom farmers have chosen to incorporate “triploid” oysters into their farms, in part because they are sterile and thus remain plump and firm through the summer season when other oysters spawn. Because triploid oysters do not expend energy-producing gametes, they can grow more quickly and reliably throughout the season. While this is beneficial for off-bottom farmers, it does not provide additional stock enhancement for the public oyster reefs in Mississippi.

Diploid oysters are crucial to spat production, recruitment and long-term viability of on-bottom oyster reefs.

In partnership with the Mississippi Development Authority (MDA), the MDMR would like to provide affordable financing to oyster farmers and other parties who want to start or expand commercial shellfish aquaculture operations in Mississippi, but also want to ensure the sustainability of our public oyster reefs. Through this proposed program, the borrowers would agree to grow 15 percent of crops as diploid oysters that would be deployed on the wild reefs in Mississippi. The oysters would be deployed in a manner that reduces the predation of single oysters. Oyster farmers would make interest-only payments, initially at 1.5 percent, for the first three years. If borrowers make their quarterly payments, 60 percent of the principal balance will be forgiven, and borrowers will repay the remaining balance over two to four additional years. The maximum single loan amount is \$400,000. Loan proceeds may be used to start an oyster nursery, oyster hatchery or purchase shell, seed or spat for farm operations. This project is projected to be funded through GOMESA and the MDMR Tidelands Program and is estimated to cost \$2,000,000. Program requirements will be determined upon approval.

E. On-Bottom Oyster Aquaculture

On-Bottom oyster harvest has been prolific in the Mississippi oyster industry. Recent natural disasters like the Bonnet Carré Spillway opening have decimated the population of on-bottom oyster reefs. The MDMR remains committed to rebuilding the on-bottom oyster industry through

new developments in the industry such as the development and implementation of on-bottom oyster aquaculture. MDMR Shellfish staff plans to research and develop guidelines and best practices for the State of Mississippi on-bottom oyster aquaculture to diversify the oyster industry, increasing its resilience.

F. Biloxi Bay Habitat Assessment

As a historic oyster reef in the Mississippi Sound, Biloxi Bay has been the subject of many restoration projects. As a result, the topography of the bay has evolved. MDMR believes it is imperative to re-map and survey Biloxi Bay. This area, laden with cultch from previous projects, is very productive, and updated maps of the area would maximize further cultch planting efforts.

Conclusion

Currently, the MDMR has seventeen (17) active projects totaling \$55,313,542 seven (7) future funded projects totaling \$26,086,425 and six (6) future unfunded projects totaling \$34,000,000.

If all projects were to be funded, we would have 30 projects that totaled approximately \$115,399,967. The MDMR has made a substantial commitment to participate in the projects listed in this document. We believe that through these projects, our agency can and will expand public reefs, promote aquaculture-based farming, restore living shorelines, promote new oyster growth and help advance remote setting and hatcheries along the Mississippi Sound.