Development of Indicators and Identification of Thresholds to Support Reef Restoration

RESTORE Council Proposal Document

General Information

Title:
Development of indicators and identification of thresholds to support reef restoration

Project Abstract:
Managing fisheries species of conservation, production and habitat value such as the eastern oyster remains challenging. Across the northern Gulf of America, restoration and management goals include ensuring resilience and sustainability of oysters, the reefs they create, and the services the reefs and oysters provide. In Texas managers aim to balance oyster reef restoration and sustainable fisheries through the use of passive (i.e., harvest management), and active (i.e., material in the water) methods. Yet, little is known regarding the outcomes of these methods on either reef resilience or functions, or sustainable fisheries within or across estuaries of different environmental conditions. Here, we propose to build on recent and on-going work that has identified suitable sites for restoration and calculated restoration and aquaculture suitability indices in order to further elucidate, at a management relevant spatial scale (i.e., reef level), oyster population demography (size class distribution, reproductive output, sex ratio), and reef ecosystem function outcomes (i.e., habitat support) in relation to reef restoration activities, environmental conditions and management regime (i.e., closure areas). This proposed effort will provide critical data to inform management decisions by providing outcome indices based on proposed restoration management and environmental conditions related to oyster reef structure, population dynamics and biodiversity and food web support.

FPL Category: Category 1: Planning Only

Activity Type: Project

Program: N/A

Co-sponsoring Agency(ies):
Texas

Is this a construction project?:
No

RESTORE Act Priority Criteria:
(IV) Projects that restore long-term resilience of the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands most impacted by the Deepwater Horizon oil spill.

Priority Criteria Justification:
Oysters are ecologically and economically important habitats that are uniquely challenging to manage because they exist as both a habitat and a fishery. Oyster reefs have experienced severe declines in Texas and across the Gulf of America due to a number of factors, including oil spills, hurricanes, and unsustainable harvests. These impacts have reduced the size and complexity of oyster reefs and diminished key habitat for numerous fish, shrimp, and crab species. There is compelling science that restoration can ameliorate lost oyster habitat, particularly when coupled with protection from harvest, enhancing biodiversity, shoreline protection, water quality, recreational angling, and more (Peters et al. 2017; Rezek et al. 2017; Blomberg et al. 2018; La Peyre et al. 2019). This proposed effort seeks to collect field-based data to quantify how management actions available to oyster ecosystem and fishery managers (habitat restoration, harvest area closures) affect oyster populations, reef ecosystem functioning, and long-term resource sustainability.

The economics for enhanced resource management decision making for oysters are compelling: the estimated value of oysters in the water is $2,000 to $40,000 per acre, which includes benefits of increased biodiversity and fish production, protected shorelines, and improved water quality. Additional benefits of oyster reefs for recreational angling are estimated at $23,000 per acre. The value of oysters in the water is much greater than that generated from commercial harvest from degraded reefs, estimated at $880 per acre. In addition, over $200M were dedicated to support oyster management and restoration through the Deepwater Horizon settlement funding (Brooke and Alfasso 2022), with over $17M focused on restoration and management of Texas oysters.

Long-term resilience of oyster reefs depends on data-driven resource management. An increased understanding of the response of oysters to management actions will help ensure equitable access to a valued public resource and promote benefits that reefs provide to coastal communities, including enhancing physical and economic resilience. Findings will help support Texas Parks and Wildlife Department (TPWD) efforts, including the proposed “Oyster Reef Restoration Program,” with the goal to sustain oyster populations and reef habitat.

Project Duration (in years): 4

Goals

Primary Comprehensive Plan Goal:
Restore and Conserve Habitat

Primary Comprehensive Plan Objective:
Restore , Enhance, and Protect Habitats

Secondary Comprehensive Plan Objectives:
Improve Science-Based Decision Making Process

Secondary Comprehensive Plan Goals:
Enhance Community Resilience

PF Restoration Technique(s):
Improve science-based decision-making processes: Develop tools for planning and evaluation

Location

Location:
Texas Estuaries

HUC8 Watershed(s):
Texas-Gulf Region(Neches) - Neches(Lower Neches)
Texas-Gulf Region(Trinity) - Lower Trinity(Lower Trinity)
Texas-Gulf Region(Galveston Bay-San Jacinto) - San Jacinto(Buffalo-San Jacinto)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(East Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(North Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(West Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Austin-Oyster)
Texas-Gulf Region(Lower Brazos) - Lower Brazos(Lower Brazos)
Texas-Gulf Region(Lower Colorado-San Bernard Coastal) - Lower Colorado(Lower Colorado)
Texas-Gulf Region(Lower Colorado-San Bernard Coastal) - San Bernard Coastal(San Bernard)
Texas-Gulf Region(Lower Colorado-San Bernard Coastal) - San Bernard Coastal(East Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Lavaca(Navidad)
Texas-Gulf Region(Central Texas Coastal) - Guadalupe(Lower Guadalupe)
Texas-Gulf Region(Central Texas Coastal) - San Antonio(Lower San Antonio)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(East Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(West Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(East San Antonio Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(West San Antonio Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(Aransas Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(Mission)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(Aransas)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Nueces(Lower Nueces)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(North Corpus Christi Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(South Corpus Christi Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(South Laguna Madre)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Sabine Lake)
Texas-Gulf Region(Central Texas Coastal) - Lavaca(Lavaca)
Texas-Gulf Region(Sabine) - Sabine(Lower Sabine)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(North Laguna Madre)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(Baffin Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(Central Laguna Madre)

State(s):
Texas

County/Parish(es):
TX - Aransas
TX - Brazoria
TX - Calhoun
TX - Cameron
TX - Chambers
TX - Galveston
TX - Harris
TX - Jackson
TX - Jefferson
TX - Kenedy
TX - Kleberg
TX - Liberty
TX - Matagorda
TX - Newton
TX - Nueces
TX - Orange
TX - Refugio
TX - San Patricio
TX - Victoria
TX - Willacy

Congressional District(s):
TX - 2
TX - 38
TX - 18
TX - 22
TX - 27
TX - 14
TX - 29
TX - 36
TX - 34
TX - 7
TX - 9

Narrative

Introduction and Overview:
In recent years, oyster harvests in Texas have begun to focus disproportionately on specific bays, prompting alarm about deteriorating reef condition, and culminating in new regulations that prohibit oyster harvests in selected areas. At the same time, widespread support has emerged for rebuilding degraded oyster reefs, with oyster reef restoration being carried out by TPWD as well as several conservation and academic groups. To support ongoing resource management decisions, it is important to understand how oyster populations in closed areas respond after harvest pressures are removed, and how restoration actions in both open and closed waters can speed recovery.

Numerous studies have compared the oyster population, habitat provision and biodiversity support on natural and restored reefs with findings differing based on location, age of reef, and

material used (e.g., Coen et al. 2007; La Peyre et al. 2015; Humphries and La Peyre 2015; Rezek et al. 2017; Smith et al. 2022). Smith et al. (2022), in a meta-analysis of restored reefs, found that restored oyster reefs can match multiple ecological functions of natural reefs but require a 6+ year time frame. Martinez et al. (2022) compared the recovery of restored and natural reefs in Texas, finding similar or higher oyster density and size on restored reefs within 18 months. Only a few locations around the United States have explicitly compared the effects of harvest closures on oyster reefs. One study in North Carolina found larger oysters and populations on restored and natural reefs within reserve areas (Peters et al. 2017); while this finding is not surprising, what remains unclear is how quickly oyster populations would change in response to harvest closures and/or openings due to this study occurring in a long-term oyster reserve. This is important to note as many of the open and closed areas within Texas have been recently harvested.

This proposed effort aims to advance oyster restoration planning, design, and assessment in Texas by working in collaboration with TPWD and Texas General Land Office (TGLO) to evaluate sustainability of restored and natural oyster reefs, in closed and open harvest areas; to identify reef design elements that will enhance habitat use by both fish and wildlife; and to quantify reef biological response to chemical and physical variables. This effort will directly inform the proposed TPWD Oyster Reef Restoration Program to develop a prioritized approach to oyster reef restoration, and it will build on previous work funded by the TGLO to identify suitable sites and create publicly available maps to advance oyster reef restoration across the Texas coast (www.oyster-restoration.org; Beseres Pollack et al. 2012).

Recent work used a mechanistic energy-based model to predict oyster survival, growth, time to market, and reproductive output across key Texas estuaries (Lavaud et al. 2024); Model outputs (oyster survival, growth, time to market, reproduction) were used to generate maps showing suitable areas for restoration and aquaculture, which were defined by the ability of reefs in these areas to survive, grow and reproduce. Using outputs from the previous work, this effort proposes to further elucidate, at a management relevant spatial scale (i.e., reef level), oyster population demography (size class distribution, reproductive output, sex ratio), and reef ecosystem function (i.e., habitat support) in relation to active (restoration) and passive (closure) management.

Proposed Methods :

Study Design:

The proposed work will use six tasks to address environmental conditions, reef structure, oyster population dynamics, and ecosystem services. Tasks 1-3 focus on reefs across the Texas coast, while Tasks 4-5 concentrate on Coastal Bend reefs to address high-salinity conditions. This region is selected for intensive study due to its higher salinity and temperature conditions which represent future conditions in several Texas estuaries, limited data availability for modeling under these conditions, and relevance to other estuaries that may experience similar environmental conditions. Task 6 summarizes the outcomes and findings for resource management.

1. Environmental conditions and reef structure:

Task 1. Develop reef-specific temporal trends of environmental regime. The environmental regime across each reef selected for this study will be characterized based on means, variance, and extreme events over recent years; similarly, projected means, variance and extreme events

in the future will be summarized and used to assess future reef exposures. Lavaud et al. (2024) used available data from long-term collections of environmental data (temperature, salinity, chlorophyll a), including, but not limited to daily data from the Texas Commission on Environmental Quality, TPWD and the USGS as well as modeled data from the TxBLEND models from the Texas Water Development Board (Schoenbaechler et al. 2011), as well as remotely sensed temperature data (i.e., Hybrid Coordinate Ocean Model, HYCOM; GODAE 2021 and Landsat 8 Thermal Infrared Sensor data). We will use these data and future condition projections and explore the addition of chlorophyll a to provide improved resolution and insight into potential oyster reef population dynamics, and potential impacts of restoration management at each site.

Task 2. Quantify reef structure. Once during the study, reef size (ha), vertical relief and variability, habitat heterogeneity, and location adjacent to other habitats and features will be measured. Reef structure metrics will be developed at the reef scale (live and dead oyster volume, reef area, vertical relief, homogeneity), and the landscape scale (distance to adjacent structured habitats, location relative to inflow, location relative to protected potential spawner reefs).

2. Oyster population dynamics:

Task 3. Quantify reef-specific oyster population dynamics. Oyster demography will be assessed annually using diver quadrat surveys. Five haphazardly located samples will be taken on each reef during winter to capture population demography (size class distribution), and reef density estimates (ind m-2). The diver surveys will involve collecting all reef material within a 0.25 or 0.07 m2 quadrat, depending on density, at the surface of the reef, and sorting the material in the lab by live and dead. All live oysters will be sized (shell height SH, mm), and intact dead oysters (box shells) will also be sized and used as an estimate of recent mortality by size class. Live and dead shell density, and volume will be determined through water displacement. In addition, dredge samples will be conducted (in passes of 30 second duration) until 40 oysters (> 50 mm SH) have been collected, to assess condition index, histology, Perkinsus marinus infection intensity, sex ratio and reproductive potential.

Task 4. Quantify reef-specific individual oyster growth. Oyster growth and mortality will be assessed at two reef locations within the Coastal Bend locations to provide site-specific measures of oyster growth rates, and mortality events from environmental conditions. We specifically selected sites in the Coastal Bend as this area represents the high salinity scenario for Texas where these types of data are lacking. At each of the selected reefs, 6 aquaculture bags (30 cm x 60 cm x 30 cm; BST Oyster Supplies) will be placed and held off bottom by 30 cm PVC legs. These bags will be used for growth, mortality, Perkinsus marinus infection intensity, plasma osmolality and condition index following methods in La Peyre et al. (2013). At each site, three bags will be filled with 50 market oysters, and 3 bags with 50 seed oysters; oysters will be placed in the field in the fall of year 2 of the study. At each sample event, water samples will be collected for chlorophyll a (ug L-1). This task will provide explicit data on oyster demographic rates, dermo infection and reproductive potential to better calibrate oyster modeling and habitat suitability; population specific differences, phenotypic variability and water quality all impact oyster demographic rates (La Peyre et al. 2021, 2024).

3. Reef ecosystem functions:

Task 5. Assess macrofauna community and oyster reef trophic level support. Macrofauna

community analysis and biomass-weighted diversity indices, will be used to assess the reef ecosystem function and service provision of biodiversity and prey species, following methods in Rezek et al. (2017) and Blomberg et al. (2017). Trays will be used to sample oysters and macrofauna. Twenty-four sampling trays (45 x 30 x 11 cm) filled with reef substrate recovered from the reef being sampled, will be placed in a shallow excavated area within the existing reef, and affixed to the reef with rebar. At each sample event, six trays will be haphazardly sampled with trays used for biodiversity. Sampling will occur quarterly over a 12-month period. This task will quantify the effects of management (open, closed) on the provision of habitat and trophic level support of restored reefs. This information will also tie directly to the TX Oyster Reef Restoration proposal providing monitoring metrics and data to compare project outcomes and habitat support and identify areas for adaptive management.

4. Synthesis for resource management:

Task 6. Integrate findings from Tasks 1-5 to evaluate the effectiveness of restoration and closure strategies. Develop recommendations for adaptive management and prioritize future restoration efforts. Deliverables will include a “lessons learned” document and maps for stakeholders.

Site Selection and Sampling:

Reefs will represent diverse environmental regimes (high-salinity Coastal Bend and low-salinity Upper Coast) and management types (open vs. closed, restored vs. natural) (Table 1). We will sample one reef from each category across each of the coastal areas (2 areas x 2 management x 2 reef status = 8 reef areas) for Tasks 1, 2, and 3 sampling to document the range of oyster, reef and environmental data across which oyster reefs exist in Texas bays. Tasks 4-5 will focus on the Coastal Bend reefs only due to data gaps and relevance to future conditions following the outlined schedule in Table 2.

Table 1. Texas bays and estuaries supporting oyster reef management, categorized by restoration management. Open refers to open for harvest, closed indicates areas with harvest closure; restored reefs indicate active restoration actions have occurred; natural reefs have not had active restoration applied. We selected reefs distributed across the low and high salinity areas, and within each category for Tasks 1, 2, 3; for Task 4 and 5, we will focus on Coastal Bend/High reefs, selecting up to two locations where reefs thrive within each region; this region is selected for more in-depth comparison, because this region is where Texas lacks the most data to inform models, and has higher salinity and temperatures (Lavaud et al. 2024), and likely represents future conditions.

	Management type			
	Open, Natural	**Open, Restored**	**Closed, Natural**	**Closed, Restored**
Region/ Salinity				
Coastal Bend/ High	Aransas	Aransas	St. Charles	St. Charles
Upper Coast/ Low	Galveston	Galveston	Sabine	Sabine

Final outputs:

1. Oyster population dynamics: Provide reef-specific data on oyster population trends and demographic metrics
2. Reef structure and environmental conditions: Quantify impacts of restoration and management on biodiversity and ecosystem services.
3. Biodiversity and trophic support: Develop indices to assess ecosystem health across reefs.
4. Water quality contribution: Estimate filtration potential (e.g., La Peyre et al. 2014) based on reef structure and oyster demographics.
5. Manager decision making: Create graphics and a “lessons learned” document for adaptive management.

Table 2. Proposed schedule by task; Tasks 1, 2, 3 would encompass a minimum of 8 reefs across coastal Texas; Tasks 4, 5 would focus on a subset of reefs to cover restoration management impacts within an environmental regime.

Quarter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Task 1	X	X	X	X	X											
Task 2					X	X	X	X	X							
Task 3					X	X	X	X	X	X	X					
Task 4					X	X	X	X	X							
Task 5					X	X	X	X	X	X	X					
Task 6									X	X	X	X	X	X	X	X
Outreach	X				X				X				X			X

Environmental Benefits:

This proposed project will 1) inform oyster population sustainability and ecosystem functioning in restored and natural reefs, 2) identify indicators and thresholds for monitoring and adaptive management, and 3) guide restoration priorities and decisions regarding harvest closures and reef designs. This project builds on previous work on oyster reefs and restoration in the northern Gulf of America including recently developed suitability index models for restoration and aquaculture across three Texas estuaries. This work will help to address some of the uncertainties identified in building these models; specifically, this work will provide Texas-specific oyster growth, mortality under environmental conditions across the range of salinity and temperature regimes in Texas estuaries. This work also will tie into the on-going RESTORE proposal (DECORATE) exploring ecosystem services of reefs across natural reefs of Texas estuaries. Using outcomes from DECORATE, results of matching parameters collected in managed and restored reefs can be benchmarked to the ranges reported in the RESTORE proposal. Additionally, this work ties into the proposed Texas “Oyster Reef Restoration Program” by directly informing decision-making related to oyster reef restoration. By including management and restoration reefs in this project, the data will be useful in identifying differences with natural reefs and identify uncertainties that should be addressed in future projects. These could include for example, how management might impact oyster demography across and the reefs, thus impacting potential metapopulation dynamics, and ecosystem services provision.

Metrics:

Metric Title: PRM010 : Research - # studies used to inform management

Target: 1

Narrative: This work will provide a minimum of one study that will provide data and information to inform management decisions. This study and the information generated to inform management will be shared with management and stakeholder as described below under collaborations but will include an annual meeting with oyster reef managers to discuss the research, and how to integrate it into Texas management decisions and prioritization of oyster restoration and management.

Metric Title: PRM009 : Research - # studies reported to management

Target: 1

Narrative: This work will provide a minimum of one study, likely composed of sub-objectives and studies resulting in the provision of a minimum of one data product, one report and/or one peer-reviewed literature to inform oyster restoration and management specifically in Texas We will publish data collected and provide other products that present and discuss the information collected detailing (1) broad scale view of oyster reef characteristics across salinity, restoration and management scenarios in Texas (tasks 1-3), (2) quantify estuary specific oyster demographic rates, disease risk, and reproductive potential (task 4) and (3) oyster reef support of ecosystem services, including biodiversity and habitat support (Tasks 5).

Metric Title: COI002 : Outreach/ Education/ Technical Assistance - # people reached

Target: 20

Narrative: Annually, we will hold a meeting with oyster reef managers to discuss the research, and how to integrate it into Texas management decisions and prioritization of oyster restoration and management; this will include key managers in Texas, numbering at least 10 individuals. Throughout the year, we will hold informal discussions and data sharing to ensure managers and stakeholders are kept up to date and have data available as it is generated to inform management. Dr. Pollack serves on several Texas Committees and working groups, including the Oyster Restoration Working Group, the Oyster Regulatory Working Group, and the Texas Oyster Advisory Committee, all of which are composed of stakeholder groups including the oyster industry, oyster farmers, TPWD resource management staff, and non-profit restoration focused groups. The Texas Oyster Advisory Committee advises the TPWD Commission on oyster management and will discuss the project findings with the Committee. These meetings and discussions will involve over 20 interactions, and a minimum of 20 unique individuals.

Risk and Uncertainties:

Potential risks and uncertainties include extreme weather events (e.g., hurricanes, flooding) and regional variability. Associated challenges may impact the proposed methods or findings, for example through damage to reefs, disruption of fieldwork, and challenges in interpreting results. However, leveraging data from these events can enhance understanding of reef resilience, for example by identifying key thresholds (i.e., Zabin et al. 2022). Additionally,

because our study design involves bays across the Texas coast, it is unlikely all areas would be similarly impacted, giving us a range of conditions (average, extreme) to evaluate.

Other risks inherent in the project are those associated with field activities; we will address those by ensuring all personnel are trained on field safety protocols in the face of extreme events.

Additionally, there may be risks in stakeholder disagreement or misalignment of expectations. Proactive and regular stakeholder communication is built into this proposed work to address potential misinterpretation or implementation challenges early and as needed.

Risks associated with the proposed methods and design will be minimized by using sound statistical design, following previously published and well-established protocols where they exist, QA/QC, peer-review and public sharing of all data as required by the U.S. Geological Survey. In addition, all publications will adhere to the USGS Fundamental Science Practices.

Monitoring and Adaptive Management:
The information generated from this will tie directly into the implementation of monitoring and adaptive management for Texas. This project will provide data to inform management decisions in both open and closed, restored and natural systems across the coast. The information will be shared by Dr. Pollack during meetings with the Oyster Restoration Working Group, the Oyster Regulatory Working Group, and the Texas Oyster Advisory Committee.

Data Management:
All data will be maintained on computers in multiple locations. Data collected will be published in a data repository such as Sciencebase.gov after peer review, and approval in adherence with the U.S. Geological Survey's Fundamental Science Practice.

Collaboration:
This project involves collaboration with USGS, TPWD, and TGLO. Co-lead Pollack serves as an appointed member on the TPWD Coastal Resources Advisory Committee—which advises the Chairman and the TPWD Commission on issues that cross fishery and geographic boundaries on the coast of Texas—and on the TPWD Oyster Restoration and TPWD Oyster Regulations Workgroups. Existing collaborative relationships will be leveraged to provide relevant stakeholders with data to develop management strategies and policies to ensure sustainability of oyster resources in Texas.

Public Engagement, Outreach, and Education:
Public engagement, outreach and education will be achieved through annual formal meetings and quarterly informal discussions with resource managers. Dr. Pollack serves on several Texas Committees and working groups, including the Oyster Restoration Working Group, the Oyster Regulatory Working Group, and the Texas Oyster Advisory Committee, all of which are composed of stakeholder groups including the oyster industry, oyster farmers, TPWD resource management staff, and non-profit restoration focused groups. The Texas Oyster Advisory Committee advises the TPWD Commission on oyster management and will discuss the project findings with the Committee.

Leveraging:

Funds: $300,000.00

Type: Leveraging

Status: Received

Source Type: Other Federal

Description: This project used an energetic budget model for oysters across three key Texas and Louisiana estuaries to assess potential restoration and aquaculture suitability under current and future projected environmental conditions. This project provides spatial maps identifying suitability.

Funds: $800,000.00

Type: Leveraging

Status: Received

Source Type: Other Federal

Description: This on-going RESTORE project, with Dr. Jennifer Pollack as a co-PI, is monitoring oyster reef health across Texas estuaries. This proposed work will build on this work by focusing explicitly on how active and passive restoration management impact the trajectory of reefs across the range of Texas estuarine conditions. This projects goal is to provide an ecosystem-scale monitoring framework exploring oyster reef functioning across natural reefs in Texas.

Environmental Compliance:
All activities proposed in this effort are considered Category 1 “planning” activities. Most do not require environmental compliance documentation for Council approval. The exception is the proposed data collection of oyster samples, reef structure and habitat samples, and corresponding water quality data. Such data collection is subject to environmental compliance laws including NEPA, ESA, MSA, NHPA, and FWCA.

We do not consider the data collection activities proposed herein to cause significant environmental impacts and are exempt based on the “Existing Department of Interior Categorical Exclusions” policy (43 CFR Part 46) (see attached). Specific language includes: 43 CFR Part 46.210 (E) “Nondestructive data collection, inventory (including field, aerial, and satellite surveying and mapping), study, research, and monitoring activities.” In addition to actions listed in the Department of the Interior (DOI) categorical exclusions in 43 CFR Part 46.210, activities proposed are also exempt for the USGS based on the DOI Departmental Manual DM Part 516 Chapter 9.5 (B) “Collection of data and samples for geologic, paleontology, hydrologic, mineralogic, geochemical and surface or subsurface geophysical investigations, and resource evaluation, including contracts therefor.”

For this specific activity, the DOI-USGS will address potential extraordinary circumstances (including listed species and cultural sites and artifacts).

Bibliography (All references listed below that were published prior to 2025 may reference the Gulf of Mexico. This nomenclature has been retained to maintain the integrity of the referenced material. The Council recognizes the name change Gulf of America):

Beseres Pollack J, Palmer TA, Resinger AS, Montagna P. 2012. A restoration suitability index model for the eastern oyster (Crassostrea virginica) in the Mission-Aransas Estuary, TX, USA. PLOS One.

Brooke S, S. Alfasso. 2022. An accounting and summary of oyster restoration projects in the Gulf of Mexico funded by Deepwater Horizon Oil disaster funds. Florida State University Coastal and Marine Lab, https://marinelab.fsu.edu/media/5183

Blomberg BN, Lebreton B, Palmer T, Guillou G, Beseres Pollack J, Montagna P. 2017. Does reef structure affect oyster food resources? A stable isotope assessment. Marine Environmental Research doi:10.1016/j.marenvres.2017.03.003

Coen, Loren D., Robert D. Brumbaugh, David Bushek, Ray Grizzle, Mark W. Luckenbach, Martin H. Posey, Sean P. Powers, and S. Gregory Tolley. 2007. “Ecosystem services related to oyster restoration.” Marine Ecology Progress Series 341 (July):303–7. 516.

DWH NRDA. 2017. Strategic Framework for Oyster Restoration Activities. June. http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Humphries AT, La Peyre MK. 2015. Oyster reef restoration supports increased nekton biomass and potential commercial fishery value. PeerJ 3:e1111; DOI 10.7717/peerj.1111.

Lavaud R, La Peyre MK, Couvillion B, Pollack JB, Brown V, Palmer TA, Keim B. 2024. Predicting restoration and aquaculture potential of eastern oysters through an eco-physiological mechanistic model. Ecological Modelling. 489: 110603.

La Peyre MK, Humphries AT, Casas SM, La Peyre JF. 2014. Temporal variation in development of ecosystem services from oyster reef restoration. Ecological Engineering 63:34-44.

La Peyre MK, Eberline BS, Soniat T, La Peyre JF. 2015. Differences in extreme low salinity timing and duration differentially affect eastern oyster (Crassostrea virginica) size class growth and mortality in Breton Sound, LA. Estuarine Coastal and Shelf Science 135:146-157.

La Peyre MK, Marshall DA, Miller LS, Humphries AT. 2019. Oyster reefs in northern Gulf of Mexico estuaries harbor diverse fish and decapod crustacean assemblages: a meta-synthesis. Frontiers in Marine Science. Doi:10.3389/fmars.2019.00666.

La Peyre MK, Marshall DA, Sable SE. 2021. Oyster model inventory: identifying critical data and modeling approaches to support restoration of oyster reefs in coastal U.S. Gulf of Mexico waters. U.S. Geological Survey Open-File Report 2021-1063, 40 p. https://doi.org/10.3133/ofr20211063

La Peyre MK, Sable SE, Marshall DA, Irwin E, Hanson C. 2024. The use of conceptual ecological models to identify critical data and uncertainties to support numerical modeling: the northern Gulf of Mexico eastern oyster Crassostrea virginica example. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science;

https://doi.org/10.1002/mcf2.10297

Marshall DA, Casas SM, Walton WC, Rikard FS, Palmer TA, Breaux N, La Peyre MK, Pollack JB, Kelly M, La Peyre JF. 2021b. Divergence in salinity tolerance of northern Gulf of Mexico eastern oysters under field and laboratory exposure. Conservation Physiology 9:coab065; doi:10.1093/conphys/coab065.

Peters JW, Eggleston DB, Puckett BJ, Theuerkauf SJ. 2017. Oyster demographics in harvested reefs vs no-take reserves: implications for larval spillover and restoration success. Frontiers in Marine Science. https://doi.org/10.3389/fmars.2017.00326

Rezek RJ, Lebreton B, Roark EB, Palmer TA, Beseres Pollack J. 2017. How does a restored oyster reef develop? An assessment based on stable isotopes and community metrics. Marine Biology 164:54-62.

Schoenbachler C, Guthrie CB, Matsumoto, J, LU Q. 2011. TxBLEND Model Calibration and Validation for the Laguna Madre Estuary. Texas Water Development Board. 60pp.

Smith RS, Lusk B, Castorani MCN. 2022. Restored oyster reefs match multiple functions of natural reefs within a decade. Conservation Letters. https://doi.org/10.1111/conl.12883

Zabin, Chela J, Laura J Jurgens, Jillian M Bible, Melissa V Patten, Andrew L Chang, Edwin D Grosholz, and Katharyn E Boyer. 2022. Increasing the Resilience of Ecological Restoration to Extreme Climatic Events. Frontiers in Ecology and the Environment 20 (5): 310–18. https://doi.org/10.1002/fee.2471.

Budget

Project Budget Narrative:
The overall budget for this project is $1,200,000. The bulk of the funds ($960,000) requested will be used for planning activities entailing data collection, analyses and visualization of the indicators and thresholds to inform oyster reef management, while the remaining funds ($240,000) will be used to support project and data management.

DOI anticipates a Cooperative Agreement with a university will be the primary method of obligation, in addition to some funding to support involvement from the Louisiana Cooperative Fish and Wildlife Research Unit.

Total FPL Project/Program Budget Request:
$ 1,200,000.00

Estimated Percent Monitoring and Adaptive Management: 0 %

Estimated Percent Planning: 80 %

Estimated Percent Implementation: 0 %

Estimated Percent Project Management: 0 %

Estimated Percent Data Management: 20 %

Estimated Percent Contingency: 0 %

Is the Project Scalable?:
Yes

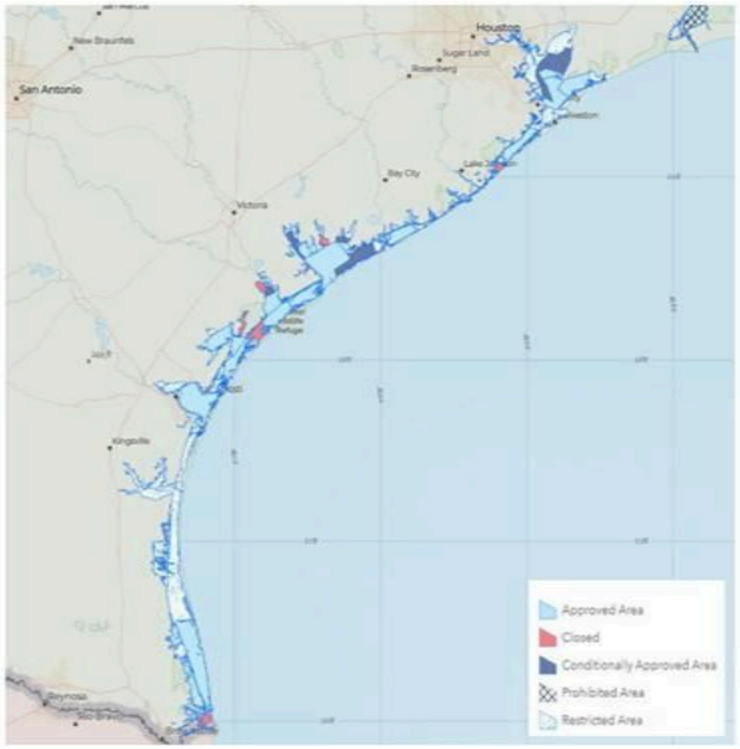
If yes, provide a short description regarding scalability.:
This project can be increased over both spatial (number of areas) and temporal (frequency and duration of sampling) scales to meet the needs of Texas resource management.

Environmental

Environmental Requirement	Has the Requirement Been Addressed?	Compliance Notes (e.g.,title and date of document, permit number, weblink etc.)
National Environmental Policy Act	Yes	See DOI “Existing Categorical Exclusions” document.
Endangered Species Act	Yes	See DOI “Existing Categorical Exclusions” document.
National Historic Preservation Act	Yes	See DOI “Existing Categorical Exclusions” document.
Magnuson-Stevens Act	Yes	See DOI “Existing Categorical Exclusions” document.
Fish and Wildlife Conservation Act	Yes	See DOI “Existing Categorical Exclusions” document.
Coastal Zone Management Act	N/A	
Coastal Barrier Resources Act	N/A	
Farmland Protection Policy Act	N/A	
Clean Water Act (Section 404)	N/A	
River and Harbors Act (Section 10)	N/A	

Marine Protection, Research and Sanctuaries Act	N/A	
Marine Mammal Protection Act	N/A	
National Marine Sanctuaries Act	N/A	
Migratory Bird Treaty Act	N/A	
Bald and Golden Eagle Protection Act	N/A	
Clean Air Act	N/A	
Other Applicable Environmental Compliance Laws or Regulations	Yes	Scientific collection permits acquired (TX)

Maps, Charts, Figures



Caption : Map of Texas coast. Areas within each bay are highlighted by their management

status in relation to oyster harvest: approved (blue), closed (red), conditionally approved (indigo), prohibited (crosshatch), restricted (stippled).

Other Uploads

Tables_1:
Table 1 and 2.docx
Table 1. Texas bays and estuaries supporting oyster reef management, categorized by restoration management.

Table 2. Proposed schedule by task;

GIS Data_2:
RESTORE_GIS_Template.gdb.zip Caption : N/A

Council Staff Review:

Development of Indicators and Identification of Thresholds to Support Reef Restoration

Note: All comments indicated below were addressed in the proposal provided above.

FPL Internal Staff Review

Project/ Program	Development of indicators and identification of thresholds to support reef restoration		
Primary Reviewer	Amy Newbold	Sponsor	DOI
EC Reviewer	John Ettinger	Co-Sponsor	Texas
1. Is/Are the selected Priority Criteria supported by information in the proposal?			Yes
Notes			
2. Does the proposal meet the RESTORE Act geographic eligibility requirement?			Yes
Notes			
3. Are the Comprehensive Plan primary goal and primary objective supported by information in the proposal?			Yes

Notes	

4. Planning Framework: If the proposal is designed to align with the Planning Framework, does the proposal support the selected priority approaches, priority techniques, and/or geographic area?	Yes
Notes	

5. Does the proposal align with the applicable RESTORE Council definition of project or program?	Yes
Notes	

6. Does the budget narrative adequately describe the costs associated with the proposed activity?	Yes
Notes	

7. Have three external BAS reviews been completed and has the proposal sponsor provided their response?	More information needed
Notes	Please see the external BAS review comments, and external reviews summary attached with these review comments.

8. Have appropriate metrics been proposed to support all primary and secondary goals?	More information needed
Notes	Two metrics were selected (PRM010 - # studies and PRM012 - # tools), however, no targets were selected. Please select targets for both metrics. Note: Restore Council staff worked with the state to resolve these comments.

9. Environmental compliance: If FPL Category 1 has been selected for the implementation component of the project or program, does the proposal include environmental compliance documentation that fully supports the selection of Category 1?	No
Notes	The 2026 FPL proposal lists this project as planning only but the narrative portion describes implementation of physical sampling of oyster reefs. Funds for physical sampling can't be approved in FPL Category 1 until applicable laws have been addressed (NEPA, ESA, NHPA, MSA and FWCA, as applicable). Either the sampling portion should be listed as FPL Category 2 (and the proposal budget and narrative modified accordingly) or DOI needs to supply the needed environmental compliance documentation Note: Restore Council staff worked with the state to resolve these comments.

Summary of Best Available Science Review:

Development of Indicators and Identification of Thresholds to Support Reef Restoration

The DOI-USGS Oyster Indicators proposal received generally positive feedback from reviewers, particularly for its relevance to the Gulf Coast region, clear objectives, and the experience of the project team. The proposal is grounded in peer-reviewed and publicly available data, primarily drawn from Texas-based research, though some reviewers noted a limited use of broader literature on oyster reef restoration. Methods were clearly described, but concerns were raised about the statistical rigor and justification of sampling design and the development of the proposed index. Risks and uncertainties—especially regarding extreme weather events—were acknowledged but not fully addressed, with reviewers recommending more detailed discussion on how these would impact outcomes and modeling. Measures of success and specific target metrics were seen as lacking or underdeveloped, and the proposal's approach to adaptive management and data monitoring was criticized for being minimal or marked as not applicable. Reviewers agreed that the proposal would benefit from a clearer risk mitigation plan, detailed metrics, and better integration of lessons from past restoration efforts. Despite these shortcomings, the project's collaborative approach and potential impact on oyster reef management were highlighted as significant strengths.

Summary of DOI's Response to BAS Comments:

The DOI response to BAS comments outlines several planned improvements and clarifications for the proposal. The team will review and correct citations, including adding missing references such as Zabin et al. (2022) and Schoenbachler et al. (2011). They will also explicitly address the risk of extreme weather events, acknowledging that such conditions could bias data but may also provide valuable insights into restoration success, as highlighted in the literature. The team plans to expand the discussion on sampling design and clarify the methodology for index creation, ensuring it aligns with the statistical design and protocols that will ensure data integrity and quality control. They will elaborate on the project's success metrics, which include both the publication of peer-reviewed studies and the number of meetings held with resource managers. The proposal will also address long-term environmental risks and how the metrics will inform management practices, particularly in the face of extreme weather events. The team will clarify that adaptive management is not part of the project, as it is not focused on implementing a specific restoration project but rather assessing existing management strategies. Finally, the team will provide more detail on the project's success metrics, risks, and sampling design, and will add language to clarify how storm impacts on oyster reefs and uncertainties will be considered in the proposal.

Best Available Science Review Forms:

Development of Indicators and Identification of Thresholds to Support Reef Restoration

Proposal Title: Development of indicators and identification of thresholds to support reef restoration
Location (If Applicable): Texas Estuaries
Council Member Bureau or Agency: U.S. Department of the Interior
Type of Funding Requested: Planning

Reviewed by: In State
Date of Review: November 4, 2024

Best Available Science:

These 4 factors/elements help frame the reviewer's answers to A, B and C found in next section:

Question 1.	
Have the proposal objectives, including proposed methods, been justified using peer reviewed and/or publicly available information?	Yes
Comments:	
The applicant points to recent publications in which this proposal is built on, along with additional peer-reviewed articles that identify the problem and the need for this type of project.	

Question 2.	
If information supporting the proposal does not directly pertain to the Gulf Coast region, are the proposal's methods reasonably supported and adaptable to that geographic area?	Yes
Comments:	
The proposal directly pertains to the Texas Gulf Coast region.	

Question 3.	
Are the literature sources used to support the proposal accurately and completely cited? Are the literature sources represented in a fair and unbiased manner?	Need more information
Comments:	
Some in-text citations are not accurate, including www.oysterrestoration.org and U.S. Geological Survey, South Central Climate Adaptation Science Center Funding. Some citations are not listed in the bibliography, including Zabin et al. 2022 and Schoenbaechler et al. 2011. Sources seem to be represented in an unbiased manner to support the proposal and tasks.	

Question 4.	
Does the proposal evaluate uncertainties and risks in achieving its objectives over time? (e.g., is there an uncertainty or risk in the near- and/or long-term that the project/program will be obsolete or not function as planned?)	Need more information
Comments:	
The applicant briefly states risk related to extreme weather events, but does not go into depth about the ways that these risks would be incorporated into the models and predictions.	

Based on the answers to the previous 4 questions, and *giving deference to the sponsor to provide within reason the use of best available science,* the following three questions can be answered:

Question A	
Has the applicant provided reasonable justification that the proposal is based on science that uses peer- reviewed and publicly available data?	Yes
Comments:	

The citations build the base for this proposal and support the objectives listed. This proposal builds upon a recent study (Lavaud et al. 2024), using this citation in multiple areas of the proposal to justify the design.

Question B	
Has the applicant provided reasonable justification that the proposal is based on science that maximizes the quality, objectivity, and integrity of information (including, as applicable, statistical information)?	Need more information
Comments:	
Statistical information was not used to justify the background of the proposal, but these details are provided in the design to justify the sampling procedures and maximize the quality and integrity of information collected.	

Question C	
Has the applicant provided reasonable justification that the proposal is based on science that clearly documents and communicates risks and uncertainties in the scientific basis for such projects/programs?	No
Comments:	
Risk is mentioned briefly in this proposal, with no citations associated with this section.	

Science Context Evaluation:

Question A	
Has the project/program sponsor or project partners demonstrated experience in implementing a project/program similar to the one being proposed?	Yes
Comments:	
The applicant lists collaborators on this project and the background that the collaborators like Texas Parks and Wildlife Department have related restoration and resource management.	

Question B	
Does the project/program have clearly defined goals and objectives?	Yes
Comments:	

The applicant stated the goal to assess reef conditions at natural and restored oyster reefs and has clearly listed tasks to achieve this goal under the design section of the proposal.

Question C	
Has the proposal provided a clear description of the methods proposed, and appropriate justification for why the method is being selected (e.g., scientifically sound; cost-effectiveness)?	Yes
Comments:	
The methods are clearly written with sufficient detail and citations from peer-reviewed publications to justify the collection methods.	

Question D	
Does the project/program identify the likely environmental benefits of the proposed activity? Where applicable, does the application discuss those benefits in reference to one or more underlying environmental stressors identified by best available science and/or regional plans?	Yes
Comments:	
The proposed project will inform future management and restoration decisions by assessing restored and natural reefs. The environmental benefits resulting in better informed restoration and management decisions are clearly listed by the applicant.	

Question E	
Does the project/program have measures of success (i.e., metrics) that align with the primary Comprehensive Plan goal(s)/objectives? (Captures the statistical information requirement as defined by RESTORE Act)	Need more information
Comments:	
The applicant lists final outputs expected from this project, but specific success measures including target metrics are not included.	

Question F	
Does the proposal discuss the project/program's vulnerability to potential long-term environmental risks (i.e., climate, pollution, changing land use)? (Captures risk measures as defined under best available science by the RESTORE Act)	Need more information
Comments:	

The applicant briefly states risk, but does not provide a detailed discussion on how risk will be incorporated into the final models.

Question G	
Does the project/program consider other applicable short-term implementation risks and scientific uncertainties? Such risks may include the potential for unanticipated adverse environmental and/or socio-economic impacts from project implementation. Is there a mitigation plan in place to address these risks? Any relevant scientific uncertainties and/or data gaps should also be discussed. (Captures risk measures as defined under best available science by the RESTORE Act)	Need more information
Comments:	
Extreme weather is listed as a risk, which may happen during the project lifecycle, but does not provide detail on how these risks may impact project design and how the project managers intend to address these risks.	

Question H	
Does the project/program consider recent and/or relevant information in discussing the elements above?	Yes
Comments:	
Nearly all publications are from the past decade, with many providing historical context to support the need for this proposed project. More recent publications within the last year are used to justify the project design.	

Question I	
Has the project/program evaluated past successes and failures of similar efforts? (Captures the communication of risks and uncertainties in the scientific basis for such projects as defined by the RESTORE Act)	Yes
Comments:	
The applicant discusses publications and studies that have reviewed similar topics and produced similar models. The applicant provides detail on gaps within this data and states how this project will differ and expand upon this past work.	

Question J	
Has the project/program identified a monitoring and data management strategy that will support project measures of success (i.e., metrics). If so, is appropriate best available science justification	Need more information

provided? If applicable, how is adaptive management informed by the performance criteria? (Captures statistical information requirement a defined by the RESTORE Act)	

Comments:

The applicant lists clear monitoring strategies with sufficient detail supported by peer-reviewed publications, but the specific measures of success are missing from this proposal. However, the applicant does state how monitoring will support the final outcomes.

Please summarize any additional information needed below:

The primary sections missing from this proposal are target success metrics and risk analysis. Target metrics may not be as applicable to planning projects like this one, but it would be helpful to understand what is expected regarding the number of studies and number of tools that the applicant hopes to develop. Weather risks are briefly stated, but not discussed thoroughly. The applicant should better describe how extreme weather will be considered in the final models and what plan is in place if weather impacts monitoring efforts. Additionally, all citations should be listed in the bibliography.

SCIENCE EVALUATION

Bucket 2: Comprehensive Plan Component

Proposal Title: Development of indicators and identification of thresholds to support reef restoration
Location (If Applicable): Texas Estuaries
Council Member Bureau or Agency: U.S. Department of the Interior
Type of Funding Requested: Planning

Reviewed by: Out of State
Date of Review: September 26, 2024

Best Available Science:

These 4 factors/elements help frame the reviewer's answers to A, B and C found in next section:

Question 1.	
Have the proposal objectives, including proposed methods, been justified using peer reviewed and/or publicly available information?	Yes
Comments:	
The cited references support the proposed objectives, including methods, which have been widely used in oyster restoration and management throughout the Gulf.	

Question 2.	
If information supporting the proposal does not directly pertain to the Gulf Coast region, are the proposal's methods reasonably supported and adaptable to that geographic area?	Yes
Comments:	
The supporting information is relevant to the Gulf Coast region, including the coastal systems along the Texas Gulf Coast.	

Question 3.	
Are the literature sources used to support the proposal accurately and completely cited? Are the literature sources represented in a fair and unbiased manner?	Yes
Comments:	
It appears to me that the literature cited came primarily from Texas-based researchers and scientists, which is a good thing, indicating high relevance to what they are proposing.	

Question 4.	
Does the proposal evaluate uncertainties and risks in achieving its objectives over time? (e.g., is there an uncertainty or risk in the near- and/or long-term that the project/program will be obsolete or not function as planned?)	Need more information
Comments:	
This was only minimally addressed. The authors limit the discussion to one sentence; they recognize extreme weather events and years, but indicate that such events would help build the models and predictions without saying how.	

Based on the answers to the previous 4 questions, and *giving deference to the sponsor to provide within reason the use of best available science,* the following three questions can be answered:

Question A	
Has the applicant provided reasonable justification that the proposal is based on science that uses peer- reviewed and publicly available data?	Yes
Comments:	

The applicant does provide justification that it is based on peer-reviewed publications.

Question B	
Has the applicant provided reasonable justification that the proposal is based on science that maximizes the quality, objectivity, and integrity of information (including, as applicable, statistical information)?	Yes
Comments:	
Although no quality assurance plan is mentioned in the proposal, it is assumed that one will be developed for any data collection activities, thus ensuring the quality and integrity of the information.	

Question C	
Has the applicant provided reasonable justification that the proposal is based on science that clearly documents and communicates risks and uncertainties in the scientific basis for such projects/programs?	Need more information
Comments:	
Again, while this consideration is recognized and mentioned in the proposal, the response does not adequately addressed the implications sufficiently.	

Science Context Evaluation:

Question A	
Has the project/program sponsor or project partners demonstrated experience in implementing a project/program similar to the one being proposed?	Yes
Comments:	
Both co-PIs have demonstrated previous experience in implementing and managing similar projects.	

Question B	
Does the project/program have clearly defined goals and objectives?	Yes
Comments:	
Primary and secondary goals and objectives are clearly defined.	

Question C	
Has the proposal provided a clear description of the methods proposed, and appropriate justification for why the method is being selected (e.g., scientifically sound; cost-effectiveness)?	Need more information
Comments:	
The methodologies are fairly well-developed and relevant to assisting in the development of effective management strategies for coastal oyster reefs. I feel they could have elaborated more on rationale and justification for some of their design in terms of temporal and spatial replication in order to validate the statistical outcomes they will be able to implement. In other words, will their design be sufficiently rigorous to provide clear differences among reef management types that will guide future management decisions.	

Question D	
Does the project/program identify the likely environmental benefits of the proposed activity? Where applicable, does the application discuss those benefits in reference to one or more underlying environmental stressors identified by best available science and/or regional plans?	Yes
Comments:	
Environmental benefits (reef ecosystem function and service) are described and referenced. They do not, however, reference the underlying stressors.	

Question E	
Does the project/program have measures of success (i.e., metrics) that align with the primary Comprehensive Plan goal(s)/objectives? (Captures the statistical information requirement as defined by RESTORE Act)	Need more information
Comments:	
The program has two measures of success: Research = # of studies used to inform management, and Tool development for decision-making = # of tools. It is difficult to determine if these metrics align with their goals and objectives as outlined in the proposal.	

Question F	
Does the proposal discuss the project/program's vulnerability to potential long-term environmental risks (i.e., climate, pollution, changing land use)? (Captures risk measures as defined under best available science by the RESTORE Act)	No
Comments:	
Their focus is on characterizing reef structure and function among differently managed (passive or active) oyster reefs along three coastal regimes. There is little (climate) to no (pollution, land use) mention of these vulnerabilities in their proposal.	

Question G	
Does the project/program consider other applicable short-term implementation risks and scientific uncertainties? Such risks may include the potential for unanticipated adverse environmental and/or socio-economic impacts from project implementation. Is there a mitigation plan in place to address these risks? Any relevant scientific uncertainties and/or data gaps should also be discussed. (Captures risk measures as defined under best available science by the RESTORE Act)	No
Comments:	
The project only mentions extreme weather events (I assume tropical storms and hurricanes) and suggests that the uncertainties and risks would help build models and predictions that account for resilience without explaining how.	

Question H	
Does the project/program consider recent and/or relevant information in discussing the elements above?	No
Comments:	
The proposers offer no explanation or reference to previous storm impacts on oyster reefs that could support their contention that these uncertainties help with management plans and decisions. No mention of adaptive management is provided in the proposal.	

Question I	
Has the project/program evaluated past successes and failures of similar efforts? (Captures the communication of risks and uncertainties in the scientific basis for such projects as defined by the RESTORE Act)	No
Comments:	
No mention of past success or failures of similar efforts were mentioned in the proposal.	

Question J	
Has the project/program identified a monitoring and data management strategy that will support project measures of success (i.e., metrics). If so, is appropriate best available science justification provided? If applicable, how is adaptive management informed by the performance criteria? (Captures statistical information requirement a defined by the RESTORE Act)	No
Comments:	

The proposers responded that monitoring and adaptive management are not applicable. The only language in the proposal regarding data management is that “all data will be maintained on computers at Harte Research Institute and LSU Agricultural Center.”

Please summarize any additional information needed below:

While I believe there are deficiencies and shortcomings that aren’t adequately addressed in sections on risks and uncertainties, data management and metrics, I do think that this is a very worthy project that will have significant benefits to the management of Texas coastal oyster reefs.

Since this review is limited to an evaluation of best available science, I am confident they have a firm grasp, understanding and application of best methods described in this proposal, with particular reference to practices undertaken specifically in Texas.

SCIENCE EVALUATION

Bucket 2: Comprehensive Plan Component

Proposal Title: Development of indicators and identification of thresholds to support reef restoration
Location (If Applicable): Texas Estuaries
Council Member Bureau or Agency: U.S. Department of the Interior
Type of Funding Requested: Planning

Reviewed by: Out of Gulf
Date of Review: October 9, 2024

Best Available Science:

These 4 factors/elements help frame the reviewer's answers to A, B and C found in next section:

Question 1.	
Have the proposal objectives, including proposed methods, been justified using peer reviewed and/or publicly available information?	Yes
Comments:	
The proposal objectives are supported by some peer reviewed and/or publicly available information, but to a limited extent. There is substantial literature on factors affecting oyster reef restoration success, and that literature is either not cited or, if cited, elaborated upon.	

Question 2.	
If information supporting the proposal does not directly pertain to the Gulf Coast region, are the proposal's methods reasonably supported and adaptable to that geographic area?	Yes
Comments:	
The proposal directly pertains to the Gulf Coast region.	

Question 3.	
Are the literature sources used to support the proposal accurately and completely cited? Are the literature sources represented in a fair and unbiased manner?	Yes
Comments:	
The cited literature is presented fairly and completely.	

Question 4.	
Does the proposal evaluate uncertainties and risks in achieving its objectives over time? (e.g., is there an uncertainty or risk in the near- and/or long-term that the project/program will be obsolete or not function as planned?)	Yes
Comments:	
The proposal presents extreme events (e.g. weather) as potentially creating conditions that would lead to the collected data only being representative of unusual or extreme conditions.	

Based on the answers to the previous 4 questions, and *giving deference to the sponsor to provide within reason the use of best available science,* the following three questions can be answered:

Question A	
Has the applicant provided reasonable justification that the proposal is based on science that uses peer- reviewed and publicly available data?	Yes
Comments:	
The proposal cites peer reviewed and publicly available data, but to a limited extent. The proposal does not summarize what has been learned in other systems regarding the successes and failures of oyster reef restoration. The primary literature that the proposal builds upon is prior work the applicants have conducted in the region, but there is science from other regions that could be cited and used to strengthen the proposal's rationale.	

Question B	
Has the applicant provided reasonable justification that the proposal is based on science that maximizes the quality, objectivity, and integrity of information (including, as applicable, statistical information)?	No
Comments:	
The study design involves sampling from reefs across different salinity and management regimes, but this inserts a lot of variation in the sampling design such that it will likely be difficult to attribute observed differences to either environmental conditions or management regimes. There is no discussion of how statistical methods may be used to account for these multiple sources of variation. A more straightforward study design would be to control for one factor (e.g., sample a passive restoration site, active restoration site, and combination of passive+active within a single salinity zone, or within each salinity zone). There is also little justification for the number of samples to be collected, and the proposed index (task 6) is not described in any statistical or mathematical detail. Constructing indices is quite challenging, as many decisions have to be made regarding the integration of factors. E.g., will factors be equally weighted? Exactly which factors will be included? There is also mention of thresholds and indicators in parts of the proposal, but these concepts are not elaborated upon in the methods.	

Question C	
Has the applicant provided reasonable justification that the proposal is based on science that clearly documents and communicates risks and uncertainties in the scientific basis for such projects/programs?	No
Comments:	
The only risk/uncertainty identified is that there may be extreme weather conditions during the sampling period, which could result in the data only being representative of extreme conditions, in which case the outputs of the project will be made specific to extreme events. However, there would likely be insufficient data to be representative of extreme conditions.	

Science Context Evaluation:

Question A	
Has the project/program sponsor or project partners demonstrated experience in implementing a project/program similar to the one being proposed?	Yes
Comments:	

The team has already worked extensively in the area, and one of the co-PIs is already leading a project focused on monitoring oyster reef health across Texas estuaries. The team has also previously developed and applied a habitat suitability index, demonstrating their past experience with creating and applying indices.

Question B	
Does the project/program have clearly defined goals and objectives?	Yes
Comments:	
The primary goal is to develop an index and outputs that help managers understand the management conditions and environmental regimes in which oyster reef restoration is most successful in terms of reef condition, population dynamics, and provisioning. There are structured tasks supporting this goal.	

Question C	
Has the proposal provided a clear description of the methods proposed, and appropriate justification for why the method is being selected (e.g., scientifically sound; cost-effectiveness)?	No
Comments:	
My primary concern with the proposal is in regard to its sampling design and plan for constructing an index (see response to question B in the prior section). In summary, there is insufficient justification for the sites to be sampled, and inadequate detail as to how all of the collected information will be synthesized into a usable metric.	

Question D	
Does the project/program identify the likely environmental benefits of the proposed activity? Where applicable, does the application discuss those benefits in reference to one or more underlying environmental stressors identified by best available science and/or regional plans?	Yes
Comments:	
Yes, environmental benefits are identified, and primarily consist of producing information to help regional managers improve the success of oyster reef restoration projects. The primary stressor is variation in management approaches and restoration design. There are no regional plans mentioned.	

Question E	
Does the project/program have measures of success (i.e., metrics) that align with the primary Comprehensive Plan goal(s)/objectives? (Captures the statistical information requirement as defined by RESTORE Act)	Need more information

Comments:
There are two metrics listed, but the target is 0 for both, and no narrative is provided. So there is inadequate information with which to assess metrics.

Question F	
Does the proposal discuss the project/program's vulnerability to potential long-term environmental risks (i.e., climate, pollution, changing land use)? (Captures risk measures as defined under best available science by the RESTORE Act)	Yes
Comments:	
The proposal considers future conditions and will compile data on future reef exposures, though it is unclear how this information will feed into any project outputs.	

Question G	
Does the project/program consider other applicable short-term implementation risks and scientific uncertainties? Such risks may include the potential for unanticipated adverse environmental and/or socio-economic impacts from project implementation. Is there a mitigation plan in place to address these risks? Any relevant scientific uncertainties and/or data gaps should also be discussed. (Captures risk measures as defined under best available science by the RESTORE Act)	Yes
Comments:	
The proposal highlights one source of risk/uncertainty, which is that there could be extreme conditions during the sampling such that the collected data are not broadly representative of typical environmental conditions. I feel the greatest risk is that the data will be too variable so as to produce an index, indicators, or management thresholds. To strengthen the risk/uncertainty section, it would help to see some description as to how the project would still produce beneficial insights even if there are no significant relationships identified.	

Question H	
Does the project/program consider recent and/or relevant information in discussing the elements above?	Yes
Comments:	
Yes, but refer to prior comments on the discussion of prior literature being limited.	

Question I

Has the project/program evaluated past successes and failures of similar efforts? (Captures the communication of risks and uncertainties in the scientific basis for such projects as defined by the RESTORE Act)	No

Comments:

No, the proposal does not elaborate on past success and failures of similar efforts. The team has previously successfully created a habitat suitability index, but through modeling efforts, making this prior work quite distinct from the proposed work.

Question J

Has the project/program identified a monitoring and data management strategy that will support project measures of success (i.e., metrics). If so, is the appropriate best available science justification provided? If applicable, how is adaptive management informed by the performance criteria? (Captures statistical information requirement a defined by the RESTORE Act)	No

Comments:

Unfortunately, the metrics were not elaborated upon, so it is challenging to assess whether the strategies support project success metrics. A brief data management summary is provided. No monitoring or adaptive management strategies are presented (listed as “not applicable”).

Please summarize any additional information needed below:

A strength of this proposal not touched upon in prior comments is its collaborations. The team spans federal and state agencies who are directly working on oyster reef restoration.