PRACTITIONER GUIDANCE FOR GEMS SOCIAL AND ECONOMIC METRICS

Oyster Reef Restoration

Abundant oyster populations across the Gulf of Mexico have historically played a key role in the health of the ecosystem and economy. The dramatic decline of oysters, estimated at 50–85% from historic levels, has damaged the stability and productivity of the Gulf's estuaries; harmed coastal economies, and undermined cultural traditions and communities. Funding from the Deepwater Horizon oil spill settlement and other resources offers a unique opportunity to reverse the decline of the Gulf's oysters.

Monitoring of Oyster Reef Restoration Projects in the Gulf: Current Practice

The science and practice of oyster restoration has advanced tremendously over the past decade, and multiple resources exist for planning, implementing, and monitoring the ecological restoration of oysters. It is critical for practitioners to be aware of the fundamental concepts of monitoring shellfish reef restoration. One key set of resources are practitioner's handbooks on oyster restoration monitoring, including specific recommendations for the eastern oyster. A group of oyster restoration experts developed a set of minimum universal metrics to assess the basic biophysical and ecological performance of oyster restoration projects that can be assessed through time, while also allowing for comparisons with other projects. Sampling of universal environmental variables (water temperature, salinity, dissolved oxygen, tidal emersion) also provides valuable information that can aid in the interpretation of data collected during reef monitoring activities. While these metrics can measure the health of the restored oyster reefs, they do not help to assess the broader social and economic benefits that result from these resources. The GEMS project aims to fill this gap.

Monitoring Social and Economic Outcomes: Recommendations from the GEMS Project

Although hundreds of millions of dollars will be spent on oyster restoration in the Gulf over the coming years, there is no shared platform to guide assessment and reporting of restoration progress and effectiveness for the broad set of social and economic goals (such as community resilience and economic revitalization) shared by the many institutions working in the Gulf. The GEMS project created a set of logic models to identify outcomes and metrics relevant across restoration projects, programs, and locations that can facilitate effective and consistent project planning and evaluation throughout the Gulf. For more information, see the GEMS project website.

THE GEMS PROJECT

GEMS: Gulf of Mexico Ecosystem Services Logic Models & Socio-Economic Indicators

With support from the National Academies of Sciences, Engineering, and Medicine – Gulf Research Program, Duke University's Nicholas Institute for Environmental Policy Solutions, The Harte Research Institute at Texas A&M University-Corpus Christi, the Bridge Collaborative, and The Nature Conservancy have developed a standard set of conceptual models linking restoration investments to social and economic outcomes and identified related metrics that can be used to track restoration success. The metrics and models serve as a starting point and should be tailored to each project.

Restoration actions, outcomes, and metrics were collaboratively developed through workshops with state representatives, restoration funders, regional decision makers, and local experts from specific estuaries to ensure applicability of the outcomes and metrics across scales. The conceptual models and metrics were further informed by literature reviews, expert interviews, and feedback from a distinguished advisory council.

nicholasinstitute.duke.edu/project/gems

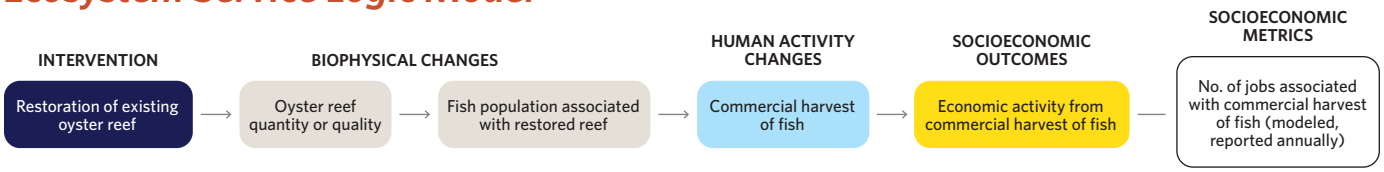
Identifying Social and Economic Outcomes for Project Justification and Monitoring

Practitioners developing projects or programs for oyster reef restoration can use the GEMS ecosystem services logic models (ESLMs) to identify specific social and economic outcomes of their project or program that link to a set of metrics which can be used for monitoring. For example, the flow chart below demonstrates a pathway resulting in socioeconomic outcomes that can be measured by metrics like number of jobs. This pathway is one part of a larger, more comprehensive ESLM. Chains of the ESLMs can also be used to tell stories about your project or program to explain how a sequence of events or activities leads to an economic or social benefit. See more about developing value chain stories from Sea Grant.

OYSTER REEF RESTORATION PROJECT TYPES

- Simple subtidal harvested
- Complex subtidal harvested
- Complex subtidal
- Complex intertidal
- Protected or enhanced
- Aquaculture

Ecosystem Service Logic Model



Visit the **GEMS website** to use ESLMs to identify the full suite of relevant social and economic outcomes for developing project justification or monitoring plans.

Recommended Social and Economic Metrics for Monitoring

The metrics below were selected by experts and practitioners in the Gulf of Mexico as core metrics relevant for monitoring the identified social and economic outcomes of oyster reef restoration. Core metrics are likely to show a significant change across multiple project types (more information on core metrics is available here). Similar to NRDA's core parameters for measuring biophysical and ecological outcomes, using core metrics allows for consistency, comparison, and rolling up results. Use this resource and the linked online database to identify the socioeconomic metrics that are relevant to your project goals.

Metrics are categorized by scale and tier. Project-scale metrics measure changes in outcomes due to one project, while program-scale metrics measure cumulative changes in outcomes for multiple projects. Tier 1 metrics require relatively few resources or specialized skills to measure, while tier 2 metrics may require bringing in partners/students with relevant skills and take more time to measure. Several socio-economic outcomes of habitat restoration have metrics that are not fully established or required data are not readily available. These "R&D" metrics are not shown here but are included in the full metrics list in the Appendix.

PROJECT SCALE

TIER 1

Economic Activity	Number of restoration jobs supported by project
	Total restoration expenditures by project

TIER 2

Cultural Values	Education-related knowledge—Number of people with additional knowledge of habitat effects and other project outcomes
	Awareness—Number of people with additional knowledge of habitat effects and other project outcomes based on project site.
	Project identified cultural value
Economic Activity	Change in recreational activity expenditures associated with project site visitation
	Number of jobs supported through recreational fishing at project site
	Change in recreational fishing expenditures associated with project site visitation
Human Health	Proportion of surveyed harvesters who say that food caught/harvested at the site is important for feeding their household
	Change in cognitive function
	Change in subjective well-being
Property Protection	Number of properties or length of infrastructure adjacent to shoreline with reduced erosion after project

PROGRAM SCALE

Cultural Values	Awareness—Number of people with additional knowledge of habitat effects and other project outcomes on broader scale.
	Program identified cultural value
Economic Activity	Change in economic activity from project associated commercial fish harvest
	Change in economic activity from recreational fishing
	Change in economic activity from restoration spending

In Depth: GEMS Recommended Metrics

SEE BELOW FOR CORE METRICS IDENTIFIED THROUGH STAKEHOLDER MEETINGS, LITERATURE REVIEW, AND EXPERT CONSULTATION. MEASUREMENT PROTOCOLS ARE ON THE GEMS WEBSITE.

TIER 1, PROJECT SCALE METRICS

Number of restoration jobs supported by project: The number of jobs directly supported by the restoration project, including but not limited to project design, construction, project site maintenance, education, and monitoring, reported every year.

Total restoration expenditures by project: The total amount of money spent on the restoration project as reported in the project budget every year.

TIER 2, PROJECT SCALE METRICS

Education-related knowledge: Number of people with additional knowledge of habitat effects and other project outcomes: The number of people with additional knowledge of habitat effects and other project outcomes due to project-associated educational outreach, assessed using project-scale methodologies such as surveys, interviews or focus groups.

Awareness: Number of people with additional knowledge of habitat effects and other project outcomes based on project site: The number of people with additional awareness of habitat effects and other project outcomes due to proximity to the project, assessed using project-scale methodologies such as surveys, interviews or focus groups.

Change in project-identified cultural value: Identification and evaluation of cultural ecosystem services (CES), which vary by community, for monitoring (e.g., Pascua et al. 2017). Where possible, project team can develop framework for pre- and post-restoration monitoring of CES.

Change in recreational activity expenditures associated with project site visitation: Estimate of total recreational activity expenditures due to the project compared to baseline of recreational activity expenditures in surrounding area, calculated as the number of recreational trips to the project site (estimated from random sampling counts as part of structured monitoring).

Number of jobs supported through recreational fishing at project site: The number of direct, indirect, and induced jobs associated with recreational fishers visiting the restored reef, based on fishing expenditures determined through a survey of recreational fishing anglers conducted by the restoration project.

Change in recreational fishing expenditures associated with project site visitation: Estimate of total recreational fishing expenditures due to the project compared to baseline of recreational fishing expenditures in surrounding area, calculated as the number of recreational fishing trips to the project site (estimated from random sampling counts as part of structured monitoring) multiplied by the average trip expenditure (from NOAA FEUS 2018 Report).

Proportion of surveyed harvesters who say that food caught/harvested at the site is important for feeding their household: Estimate of proportion of surveyed harvesters who say that food harvested at project site is important for feeding their household and if that has changed since project installation.

Change in cognitive function: Change in performance on simple recall or other cognitive function tests pre- and post-recreation activity or time at project site.

Change in subjective well-being: Change in self-reported state of well-being. Survey of visitors pre- and post-time at project site.

Number of properties or length of infrastructure adjacent to shoreline with reduced erosion after project: Total amount of public infrastructure or private property (measured in number and type of properties, or length of road) that experiences decreased adjacent erosion rates due to the restoration project, reported every year.

TIER 2, PROGRAM SCALE METRICS

Awareness: Number of people with additional knowledge of habitat effects and other project outcomes on broader scale: The number of people with additional awareness of habitat effects and other project outcomes due to living or working in proximity to the project, assessed using program-scale methodologies such as surveys, interviews or focus groups.

Change in program-identified cultural value: Identification and evaluation of cultural ecosystem services (CES), which vary by community, for monitoring. Where possible, program team can develop framework for pre- and post-restoration monitoring of CES.

Change in economic activity from project associated commercial fish harvest: Jobs, labor income, gross state product, and total industry output modeled annually based on NOAA commercial harvest data and state data (e.g., Florida commercial fisheries) for relevant species.

Change in economic activity from recreational fishing: Jobs, labor income, gross state product, and total industry output modeled annually at a county to regional level. Angler surveys will account for the difference in activity associated with a restoration project, which would then be used as input into the economic impact analysis (see Texas Half Moon Reef example).

Change in economic activity from restoration spending: Jobs, labor income, gross state product, and total industry output modeled based on project expenditures

Applying the GEMS Metrics to a Gulf Oyster Reef Restoration Project: Half Moon Reef

Half Moon Reef, a 54-acre restored oyster reef in Texas' Matagorda Bay, is a large-scale restoration project that has generated remarkable ecological, social, and economic benefits across the bay. In 2013, The Nature Conservancy partnered with the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Texas General Land Office, Texas A&M University, and private foundations on a multi-year project to restore Half Moon Reef. Today, it stands as one of the largest oyster restoration projects in the country.

The restored habitat has generated large oysters and an increase in biodiversity—more shellfish, small invertebrates, and fish like flounder and redfish in and around Half Moon Reef—to create an increasingly popular hotspot for hundreds of sport anglers across the region.

Half Moon Reef was one of the first Gulf oyster restoration projects to monitor for the types of social and economic outcomes that are being proposed by the GEMS project. The Nature Conservancy, working together with Texas Sea Grant, surveyed anglers and fishing guides from August 2015 to January 2016 to determine the social and economic benefits of increased recreational fishing in Matagorda Bay due to the restoration of Half Moon Reef.

Half Moon Reef Oyster Reef Restoration Project

Project-Scale Metrics

Here we show how the GEMS project-scale metrics relate to the Half Moon Reef project. Metrics in blue boxes represent project-scale metrics that were measured at Half Moon Reef. Gray boxes are metrics that were identified as relevant by GEMS but were not measured at Half Moon Reef. Program-scale metrics, not shown here, are measured to reflect the cumulative impact of multiple project types within a program. These include economic activity from project associated commercial fish harvest, commercial wild shellfish harvest, restoration spending, and recreational fishing as well as number of people with additional knowledge on a broader scale.

Change in cognitive function

Miles of protected shoreline adjacent to property

Recreational fishing expenditures: $1.2 million in annual economic activity

People with knowledge gained: 45% of anglers were aware of Half Moon Reef restoration*

**GEMS metrics are more likely to measure knowledge of oyster habitat and other project outcomes*

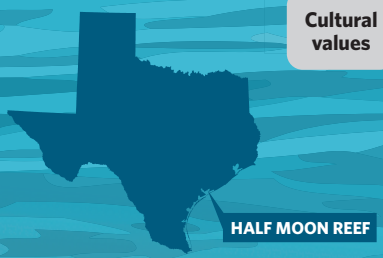
Cultural values

Restoration expenditures: approximately $4 million for construction of Half Moon Reef

Recreational fishing jobs: 12 new jobs and $465k in annual labor income

Restoration jobs: 17 jobs over the life of the project:
3 TNC staff
3 engineers
9 contractors for reef build
2 contractors for buoy maintenance

Proportion of harvesters who say food from the site is important for feeding their household



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The Nature Conservancy

TEXAS A&M UNIVERSITY CORPUS CHRISTI | HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES

BRIDGE COLLABORATIVE

For more information, visit nicholasinstitute.duke.edu/project/gems

Appendix: Full Metrics List for Oyster Restoration Projects

This list includes all metrics that are likely to show a significant change from at least one of the oyster reef restoration project types. Additional details about these metrics, including measurement protocols for tier 1 and 2 project-scale metrics, are available on the GEMS website.

The relevant project types column lists the types of oyster reef restoration projects for which the metric is expected to show a significant change. Oyster reef restoration project types are simple subtidal harvested (SSH), complex subtidal harvested (CSH), complex subtidal (CS), complex intertidal (CI), protected or enhanced (PE), and aquaculture (AQ).

OUTCOME	METRIC	TIER	SCALE	RELEVANT PROJECT TYPES
Cultural Values				
Other	Change in project identified cultural value	2	Project	SSH, CSH, CS, CI, PE, AQ
Other	Change in program identified cultural value	2	Program	SSH, CSH, CS, CI, PE, AQ
Knowledge	Education-related knowledge: Number of people with additional knowledge of habitat effects and other project outcomes	2	Project	CS, CI, PE
Knowledge	Awareness: Number of people with additional knowledge of habitat effects and other project outcomes on broader scale.	2	Program	CS, CI, PE
Knowledge	Awareness: Number of people with additional knowledge of habitat effects and other project outcomes based on project site.	2	Project	CS, CI, PE
Economic Activity				
Restoration/Intervention	Number of restoration jobs supported by project	1	Project	SSH, CSH, CS, CI, PE, AQ
Restoration/Intervention	Total restoration expenditures by project	1	Project	SSH, CSH, CS, CI, PE, AQ
Restoration/Intervention	Change in economic activity from restoration spending	2	Program	SSH, CSH, CS, CI, PE, AQ
Finfish/Shellfish harvest	Change in economic activity from project associated commercial fish harvest	2	Program	SSH, CSH, CS
Recreation and tourism	Change in recreational activity expenditures associated with project site visitation	2	Project	CSH, CS, PE
Recreation and tourism	Number of jobs supported through recreational fishing at project site	2	Project	CSH, CS, PE
Recreation and tourism	Change in recreational fishing expenditures associated with project site visitation	2	Project	CSH, CS, PE
Recreation and tourism	Change in economic activity from recreational fishing	2	Program	CSH, CS, PE
Finfish/Shellfish harvest	Number of aquaculture jobs supported by project	1	Project	AQ
Finfish/Shellfish harvest	Change in economic activity from project associated commercial aquaculture harvest	2	Program	AQ
Human Health				
Food security for communities	Proportion of surveyed harvesters who say that food caught/harvested at the site is important for feeding their household	2	Project	CSH, CSH, CS, PE
Food security for communities	Proportion of protein or nutrition from food harvested at restoration site	R&D	Program	CSH, CSH, CS, PE
Mental health and psychological well-being	Change in cognitive function	2	Project	CSH, CS, PE
Mental health and psychological well-being	Change in subjective well-being	2	Project	CSH, CS, PE
Property Protection & Value				
Property protection (erosion)	Number of properties or length of infrastructure adjacent to shoreline with reduced erosion after project	2	Project	CS, CI, PE