Restoration Notes

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A Stressors-based Ecosystem Restoration Needs Assessment to Inform Gulf Coast Restoration Decision Making

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Ten years ago on April 20, 2010, the Deepwater Horizon drilling platform in the northern Gulf of Mexico exploded, releasing an estimated 3.19 million barrels (134 million gallons or 507 million liters) of crude oil into Gulf waters over the course of 87 days. This resulted in the largest offshore marine oil spill in U.S. history, with a total volume more than twelve times that of the 1989 Exxon Valdez spill. Natural resource trustees concluded that the injuries caused by the spill affected such a wide array of interconnected resources over such an enormous area that the effects constitute an ecosystem-level injury. As a result, fines and penalties resulting from the spill can be used not only to address direct impacts from the spill itself, but also to address stressors resulting in the chronic, long-term degradation of the Gulf of Mexico ecosystem, such as coastal land loss, degraded water quality, and urbanization. More than $16 billion became available for ecosystem and economic restoration and recovery of the Gulf of Mexico ecosystem. With this money the nation has embarked on the largest restoration effort in U.S. history, but even this vast sum will not be enough to address the myriad challenges facing the Gulf.

To achieve the greatest collective benefit from restoration efforts, decision makers must invest in the health and productivity of the Gulf ecosystem by prioritizing investments that meaningfully address the restoration needs of each estuary and the Gulf of Mexico as a whole. Restoring natural ecological processes, from freshwater flows to sediment delivery, is perhaps the most effective way to make a substantive, lasting improvement to the health of the Gulf, while enhancing the resilience of coastal communities and providing a more sustainable platform for subsequent restoration projects, such as marsh and oyster reef restoration. However, with funds flowing from a number of sources, each governed by their own rules, prioritizing restoration efforts is not an easy task. The restoration needs in the Gulf of Mexico are alarming, and the dollars available for restoration still fail to cover the needs of five coastal states. Identifying synergies between projects and coordinating wise investments across political boundaries are crucial for the large-scale restoration of this national asset.

A critical first step in developing effective watershed-based restoration strategies for coastal systems is to develop an understanding of stressors and how they impact the natural resources of those systems. There have been many habitat assessments and restoration plans developed by federal, state, and local entities since the oil spill that have furthered our understanding of the stressors and needed restoration strategies across Gulf Coast estuaries. However, synthesizing the findings from these many studies and planning efforts is needed to prioritize the most effective and appropriate strategies to reach habitat restoration targets across those estuaries and to guide funding decisions for restoration projects.

To help address this need and facilitate this process, we developed a Stressors-based Estuarine Restoration Needs Assessment (SERNA) as a framework for identifying priority restoration projects in watersheds across the northern Gulf of Mexico (Figure 1). This SERNA framework outlines a science-based and systematic approach for assessing critical stressors, determining restoration needs, establishing restoration targets, and making recommendations on projects that address needs in priority geographic areas. This framework can support collaboration in the planning process by inviting diverse stakeholders across a watershed to participate in the process. This can advance buy-in within the watershed; bring new information to bear on the most pressing issues facing watersheds; and equip decision makers with resources needed for long-term restoration success. Decision makers can apply SERNA for a particular allocation of funding (e.g., Natural Resource Damage Assessment allocations) to maximize those investments. SERNA is also flexible in that it is scalable both spatially (e.g., watershed, estuary, or sub-basin) and temporally (e.g.,

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Figure 1. The Stressors-based Ecosystem Restoration Needs Assessment (SERNA) is a framework that includes seven major steps for identifying priority restoration strategies and projects in watersheds.

projects reasonably implementable within short versus long time frames).

Figure 1 outlines the major steps of the SERNA framework. The first step (top) is to compile and synthesize ecosystem restoration plans and reports (e.g., habitat assessments, estuary management plans, etc.) for an area of interest. This directly informs the next step, which is to identify key estuary stressors. The third step is to identify needed restoration strategies and establish desired outcomes. Restoration projects that align with those strategies and that target needs are identified. Scientists and environmental planners have demonstrated the importance of classifying stressors (sometimes referred to as "threats") to promote information sharing and consistency when assessing conservation actions (Salafsky et al. 2008). SERNA embraces this classification approach by standardizing the way that ecosystem stressors are organized (i.e., broad issue areas) and restoration strategies assessed based on how they address identified stressor. This then allows decision makers to run scenarios by which different suites, or combinations, of projects can be evaluated based on sequencing (i.e., the order of project implementation) and feasibility. For example, acquiring coastal land may be necessary to avoid development before investments in shoreline stabilization are made. This can help ensure subsequent investments do not detract from previous investments and allows decision makers to collectively assess the positive impacts a suite of projects may have on a system, relative to other combinations of projects. Lastly, this step-wise approach results in a portfolio of projects to guide funding decisions.

Although in most estuarine systems there is a reasonable understanding of restoration needs, there may not be quantified restoration targets (i.e., desired restoration outcomes). Establishing a comprehensive understanding of ecosystem needs is critical for determining restoration targets over different timelines and ensuring restoration investments are accomplishing the goals set forth in restoration planning. Restoration targets might consider a particular threshold (or tipping point) for a particular species, or group of species, related to a key stressor to establish timelines for management actions and avoid irreversible change or collapse (Powell et al. 2017). For instance, a marsh restoration strategy may consider future sea level rise impacts to a target foundational species. When it is not possible to set specific targets, we recommend at a minimum setting a desired, quantifiable restoration goal toward which decision makers can aim when assessing and prioritizing projects.

SERNA can be used to evaluate additional environmental and socio-economic benefits of restoration projects. Figure 2 depicts a more detailed version of SERNA intended to illustrate how the framework can be populated, with examples provided below each step, and how co-benefits of restoration projects can be considered. From left to right, the first four columns represent the same steps in Figure 1, informed by an initial synthesis of ecosystem plans and reports. The last two columns show how co-benefits of restoration can be considered for different suites of projects and potentially factored into decision making. Measuring co-benefits of restoration activities may require obtaining additional data beyond that contained in habitat assessments and restoration plans, depending on the benefits of interest. However, identifying the potential co-benefits that restoration investments can provide for communities can serve as incredibly valuable for communicating a project's broader impact and, in some instances, prioritizing investments in a financially constrained environment. When similar projects are compared in this manner (e.g., two wetland restoration projects of the same scale tackling the same stressors), a project that could provide additional storm protection for coastal properties and infrastructure may warrant prioritization, depending on the needs and interests being considered in the decision-making process.

Monitoring and adaptive management of restoration activities are critical to ensure long-term restoration goals are successfully achieved. This framework further supports these processes, as depicted in Figure 2 through feedback loops. Adaptive management includes monitoring and assessment to track whether projects are meeting desired outcomes and if modifications to a project's design may be needed, as well as to periodically reassess needs. The adaptive management process further considers how restoration activities are affecting stressors over time as

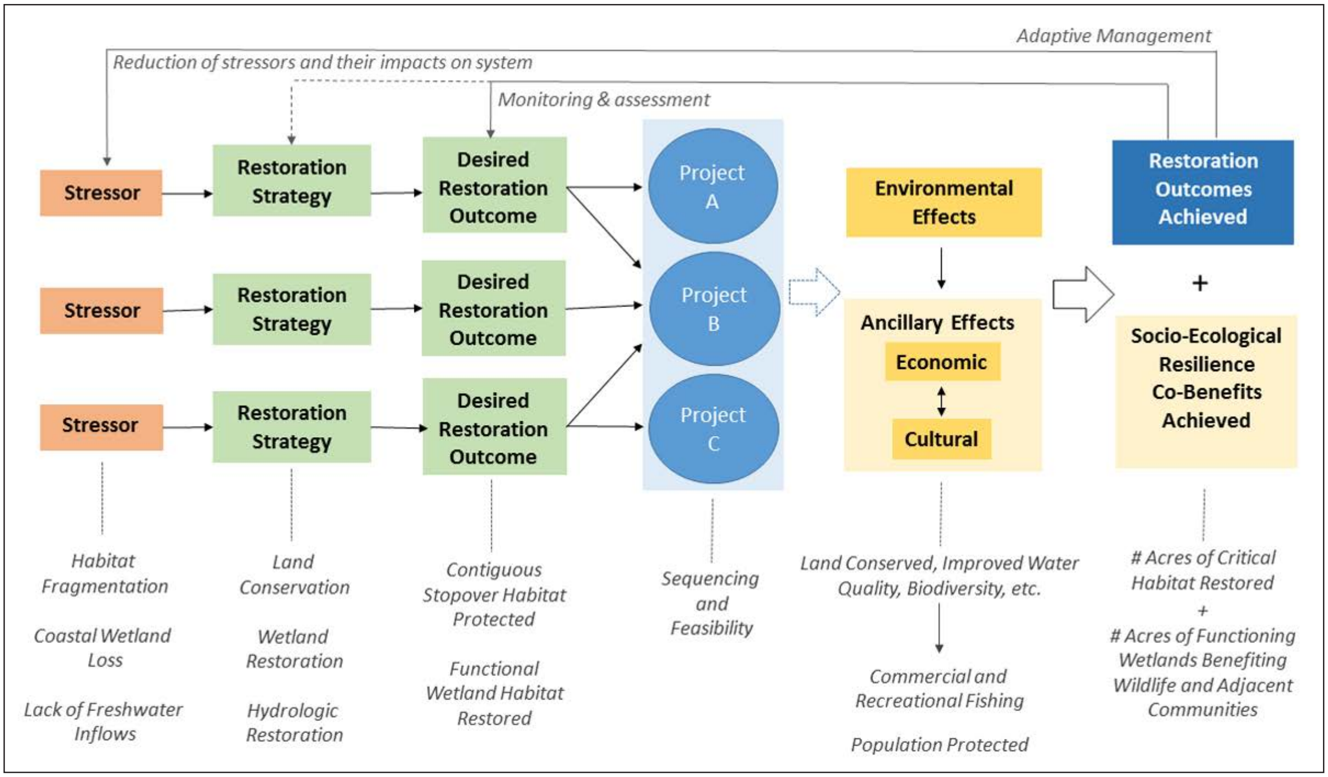

Figure 2. This detailed version of the Stressors-based Ecosystem Restoration Needs Assessment (SERNA) shows how this framework can support monitoring and adaptive management, as shown by feedback loops at the top of the image, and allows for the incorporation of additional, or ancillary, benefits derived from restoration projects, as shown on the right side of the image. The text at the bottom, in italics, represents examples of how each step of the SERNA framework could be applied and populated.

conditions change and as restoration outcomes materialize. Planners and practitioners may select common indicators to consistently monitor outcomes across projects and programs. Experts have developed a preliminary list of potential indicators that can easily be adapted and used in the SERNA framework, such as shoreline erosion rate, vegetative cover, and recruitment trends (see Baldera et al. 2018), and more general conditions for determining priorities (Clewell et al. 2005).

As the Gulf of Mexico region continues to recover from the Deepwater Horizon oil spill, state and federal leaders have a responsibility to invest wisely in the long-term health and resilience of its coastal lands and waters. We encourage decision makers to invest in the health and productivity of the Gulf by prioritizing investments that meaningfully address the specific restoration needs of each estuary across the five U.S. Gulf States. These estuaries are not only key ecological features of the region, but serve as the lifeblood of coastal communities and businesses. Their protection and restoration are key to both the near-term recovery and the long-term resilience of the Gulf of Mexico. Further, a restoration decision-making framework such as SERNA can be a useful tool for assessing and prioritizing restoration activities in watersheds across the country.

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