

## Purpose

Just after the Deepwater Horizon oil spill in 2010, TNC developed the first Restoration Explorer, an app that allows stakeholders to map areas that are suitable for oyster reef restoration based on both ecological and socioeconomic criteria. The Restoration Explorer app provides an interactive user interface that allows users to use sliders to visualize locations most appropriate for oyster restoration investment based on the criteria that are most important to them. The suitability criteria include a suite of ecological, social, and economic criteria. To date, this app has contributed to post-disaster recovery and restoration efforts throughout the Gulf, in particular in Alabama.

For the Restoration Explorer in North Carolina, the app allows stakeholders to choose a restoration type, Living Shorelines (for the Albemarle and Currituck Sounds), Subtidal Shoreline Oyster Reefs, or Intertidal Oyster Reefs. Suitability criteria are specific to the restoration type and for a specific geographic region.

## How the Restoration Explorer Works

The aim of the Restoration Explorer is to support scenario planning at a state or region scale. When a user interacts with the app, they have the ability to assign a number of weights to the various individual parameters. These weights are assigned through the interface by sliding a bar to select a value between 0 and 10. When the user assigns a weight in this manner, the predefined values for each parameter are then multiplied by the weight assigned to it. The pre-defined values for each parameter can be found in the Map Layers app under “Restoration Explorer Data Layers.” The user-defined weighted parameters are combined to produce an overall score of restoration suitability in the following equation:

$$\text{Score} = \frac{\sum_{i=1}^n \text{weight}_i * \text{parameter value}_i}{\sum_{i=1}^n \text{weight}_i}$$

Where  $n$  in the above equation is the number of parameters.

Sliding the bar to 0 eliminates the parameter from being included in the suitability analysis. A user assigning a weight of 1 will cause the original parameter value to carry through into the score sum equation. The values displayed on the map are rescaled to a range of 0 – 100. Values in the range from 0 – 20 are assigned “Low”, 40 – 60 “Medium”, 80 – 100 “High” and then assigned a color for display as referenced in the Legend.

## Suitability Parameters Included in the Restoration Explorer: Subtidal Shoreline Oyster Reefs

\* Due to the amount of boat traffic in and around the Intracoastal Waterway in this study area, it was a priority that oyster restoration projects should not impede these areas. Based on federal guidelines, areas located within 50 feet of either side of a navigation channel, within 150 ft of marinas, boat access points, or anchorage areas, or overlapping dredge disposal areas were excluded from this analysis. In addition, areas beyond 1 mile from the shoreline have been excluded from this analysis as they would not be suitable for subtidal shoreline reefs.

## Ecological Variables

*Depth-* Oysters are able to thrive at a variety of depths, however, for the objectives of this project, the depth of placement was restricted to a maximum of 6 feet. All areas 6ft deep or less were scored 4 with remaining areas scored 0. Data Sources: NOAA Bathymetry (2000).

*Salinity-* Salinity between 6-25 ppt is most suitable for oyster growth. Zones of optimal salinities between 10-15 ppt were scored as most suitable while also limiting susceptibility to the boring sponge and received a value of 4. Salinities between 6-10 and 15-25 ppt are still very good but not optimal and were assigned a value of 2. Remaining areas (< 6 ppt and >25 ppt) are not suitable for oyster growth and were scored 0. Data Sources and Methodology:

Durham, C.L. 2009. Spatial Dynamics in an Estuarine System: Modeling Biophysical Components and Interactions to Advance Fisheries Management. MS Thesis, NC State University, Raleigh, NC 27695-8208, 145 pp. (Electronic Theses and Dissertations available [here](#).)

Eggleston, D.B., C. Hardy, R. Luettich. 2014. Informing habitat enhancement in Pamlico Sound. Coastal Recreational Fishing License Final Report. 66 pp.

*Existing Oyster Reefs-* Areas closer to established reefs are favorable for recruitment. Areas within 1 mile from existing oyster cultch planting sites and sanctuaries or naturally occurring reefs were scored 4, all remaining areas were scored 0. Data Sources: Oyster Sanctuaries; Existing Oyster Cultch Planting Sites – NC Department of Marine Fisheries (2014)

*Historic Oyster Reefs-* Oysters are likely to be successful in areas where they historically have been productive. However, conditions may have changed in the given time span such that restoration may no longer be suitable in these areas. It's also important to note that experts with local knowledge were less confident in the accuracy of the historical dataset. Therefore, this parameter was weighted as less important in determining oyster restoration suitability and areas within 1 mile of a historic reef were scored 2, while all other areas were scored 0. Data Sources: Historic Oyster Reefs digitized from maps - Lt. Francis E. Winslow (1887).

*Proximity to Connected Salt Marsh-* Salt marshes and oyster reefs work synergistically; there will likely be higher biodiversity, sediment accretion, etc. if oyster reefs are near marshes that are functionally connected to the shoreline. Areas within 50 m of a salt marsh that have not been disconnected from the shoreline by structures parallel to shore (bulkhead, riprap) were scored 4, other areas were scored 0. Data Sources: Estuarine Shoreline Structures – NC Division of Coastal Management (2006-2010); Salt Marsh Habitat – South Atlantic Bite Marine Assessment (SABMA) (2014).

*Sea Bottom Type-* Firm substrate without vegetation or shell is ideal for oyster growth. Existing benthic habitat is either intertidal or subtidal Firm, w/o vegetation, w/out shell = 4, other = 0. Data Sources: Estuarine Benthic Habitat Mapping - NC Division of Marine Fisheries (2013).

*Proximity to Strategic Habitat Areas-* The North Carolina Division of Marine Fisheries and the Albemarle-Pamlico National Estuary Partnership have identified important conservation areas for coastal fish and

shellfish habitat. Reefs located within or near these areas may contribute positively to the health of the estuarine system. Areas within the boundary of or within a 1 mile area of these locations (but excluding submerged aquatic vegetation) have a score of 4, other areas have a score of 0. Submerged aquatic vegetation are removed because new oyster habitat cannot replace existing SAV habitat. Data Source: North Carolina Division of Marine Fisheries (2012).

### **Socio-Economic Variables**

*Shoreline Erosion-* Oyster reefs can be placed adjacent to eroding shorelines to help attenuate waves and stabilize shorelines. To identify portions of the shoreline that are currently vulnerable to erosion, we used a portion of the USGS Coastal Vulnerability Index. The very highest shoreline erosion rates were excluded from analysis and the remaining relative shoreline erosion rates were reclassified into quartiles with scores of 0, 2, 3, and 4. A score of 4 indicates areas with the highest erosion rates and a score of 2 indicates areas of low erosion. The scores were then allocated to the nearshore areas (within 2km of shore) adjacent to the shoreline. All remaining areas were scored 0. Data Sources: USGS Coastal Vulnerability Index (2010).

*Water Quality-* Areas of closed waters are weighted higher due to the potential benefit of oysters filtering the water. Areas currently closed = 2, other = 0. Data Sources: Shellfish Growing Areas – NC Department of Environment and Natural Resources: Shellfish Sanitation and Recreational Water Quality Section (2011).

*Public Accessibility-* Boating access to the reef site may make the project easier to construct and monitor. Boaters and fishers will not have as far to travel to benefit from potential finfish productivity. If a user does not require public access to their reef site, they can adjust the slider to zero and remove it from analysis. Areas within 5 miles of a Wildlife Resource Commission public boat access have a score of 2, all other areas have a score of 0. Data Source: North Carolina Wildlife Resource Commission Division of Engineering and Lands Management (5<sup>th</sup> Update).