UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
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June 5, 2015

MEMORANDUM FOR: Leslie Craig
Southeast Region Supervisor, NOAA Restoration Center

FROM: Virginia M. Fay
Assistant Regional Administrator, Habitat Conservation Division

SUBJECT: Essential fish habitat review of the Texas Rookery Islands Project

In response to the Deepwater Horizon oil spill, NOAA and the other Trustee agencies propose to fund the construction of three bird rookery islands in Galveston Bay and one bird rookery island in East Matagorda Bay, Texas using Phase IV Early Restoration funds. The project activities described in the EFH assessment would result in temporary and permanent impacts to estuarine water column and underlying submerged estuarine soft bottom habitat categorized as essential fish habitat (EFH) under provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

As specified in the Magnuson-Stevens Act, EFH consultation is required for federal actions which may adversely impact EFH. The NOAA's Restoration Center prepared an EFH assessment for this project and provided the document for our review by electronic mail dated May 27, 2015. The Southeast Region's Habitat Conservation Division (SER HCD) has reviewed the EFH assessment and finds the document adequately evaluates proposed project impacts to EFH supportive of a number of federally managed fishery species. Project implementation would directly impact estuarine soft bottom EFH to create upland colonial waterbird nesting islands. Both dredging and fill placement locations would be sited to avoid sensitive estuarine habitats such as oyster reefs and seagrasses. Best management practices to minimize both short term construction impacts and long term impacts to sensitive habitats have been developed and were included in the EFH assessment. The SER HCD has no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the Magnuson-Stevens Act at this time. Further consultation on this matter is not necessary unless future modifications are proposed and such actions may result in adverse impacts to EFH.

cc:
F/HC2 - Jennings, Schubert
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Essential Fish Habitat Assessment for the Texas Rookery Islands Project

Texas Rookery Islands Project

Contents

1 INTRODUCTION

The purpose of this document is to present the findings of the Essential Fish Habitat (EFH) assessment conducted for the proposed Texas Rookery Islands project in Texas State Waters as required by the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended through 1996 (Magnuson-Stevens Act). The objectives of this EFH Assessment are to describe how the actions proposed by the Texas Rookery Islands project may affect EFH designated by the National Marine Fisheries Service (NMFS) and Gulf of Mexico Fisheries Management Council (GMFMC), for the area of influence of the project. According to the GMFMC, EFH within the Gulf of Mexico (Gulf) includes all estuarine and marine waters and substrates from the shoreline to the seaward limit of the Exclusive Economic Zone (EEZ).

This assessment will include a description of the proposed action; a summary of EFH within the vicinity of the project area; a description of each Fishery Management Plan; an analysis of the direct, indirect and cumulative effects on EFH for the managed fish species and their major food sources; our views regarding the effects of the proposed action; and proposed best management practices which will minimize the potential for negative effects.

2 PROJECT DESCRIPTION

The Texas Rookery Islands project would restore and protect three rookery islands in Galveston Bay and one rookery island in East Matagorda Bay. The primary goal of the project is to partially compensate for injuries to birds by increasing nesting pairs of colonial waterbirds. Restoration actions at each rookery island would increase the amount of available nesting habitat by expanding the size of the island and enhance the quality of habitat by establishing native vegetation. Habitat longevity would be increased by expanding the size of the island, establishing vegetation, and constructing protective features, such as breakwaters or levees. These restoration actions would result in an increase in the numbers of nesting colonial waterbirds. Rookery islands in Galveston Bay include Dickinson Bay Island II, located within Dickinson Bay; Rollover Bay Island, located in East (Galveston) Bay; and Smith Point Island, located west of the Smith Point Peninsula. Dressing Point Island lies in East Matagorda Bay and is part of the Big Boggy National Wildlife Refuge (Figure 1 1).

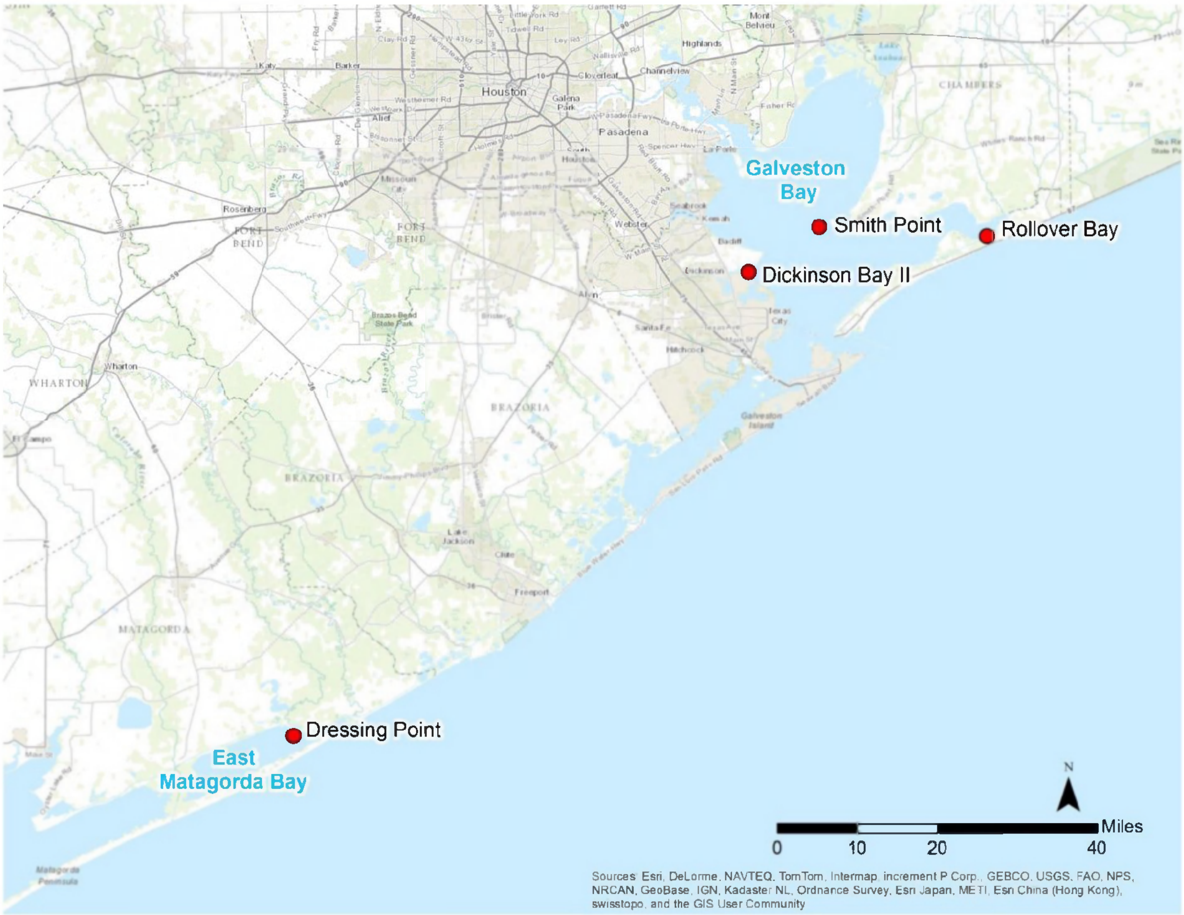

Figure 1. Texas Rookery Islands Project Locations.

The general conceptual design for the restoration and protection of the rookery islands would include raising the elevation and area of the islands using clean fill material, building structures to reduce erosion and to contain fill material (armored levees, breakwaters, and/or temporary levees), planting native scrub-shrub habitat for wading birds and brown pelicans and, for Smith Point and Dressing Point Islands, creating or enhancing habitat for ground nesting terns. Uncontaminated earthen fill would be placed on submerged bay bottom and shell material would be placed on top of the existing island to raise elevations. Island construction would use clean sediments consisting of clay, silts, and sand, which would be sculpted to prescribed slopes and elevations. Once the earthen fill has dewatered and sediments have settled, a portion of the island would be planted with native scrub-shrub vegetation. The islands would be protected by armored levees or breakwaters to ensure longevity of the restored habitat against forces that caused the loss of the original islands. The final elevation of the improved island would be such that it would support nesting species of colonial waterbirds.

Preliminary engineering has been completed for the Dickinson Bay II and Dressing Point Islands. The plans developed for Smith Point and Rollover Bay Islands are currently conceptual in design. Refined design and construction specification packages for each of the islands would be developed by professional licensed engineers (PE) with coastal restoration experience. There will be continued coordination (both formal and informal) with NMFS Habitat Conservation Division, Galveston Office regarding the planning efforts for the Texas Rookery Island Project. The following descriptions for each of the island construction elements are preliminary and based on current planning efforts and resource agency experience with similar projects. **Error! Not a valid bookmark self-reference.** summarizes the proposed construction tasks for each island.

Table 1. Proposed Restoration and Protection Actions

RESTORATION AND PROTECTION ACTIONS	RESTORATION OUTCOME
Dickinson Bay Island II (Galveston Bay)	
Construct 4 island acres by placing clean fill over submerged land	Constructed rookery island acres restores nesting habitat for colonial waterbirds
Construct 2,000 feet of armored levees	Armored levees contain island material, protect the island from erosion, and maintain structure for the expected lifespan of the project
Build 0.8 acres of submerged levee	Submerged levee creates a water/shore interface for avian use and provides wave protection
Plant 3.5 island acres with native scrub-shrub vegetation	Enhanced scrub-shrub habitat provides nesting for colonial waterbirds (wading birds)
Rollover Bay Island (Galveston Bay)	
Construct 10 island acres by placing clean fill over submerged land or existing island	Constructed rookery island acres restores nesting habitat for colonial waterbirds
Construct 4,500 feet of armored levees	Armored levees contain island material, protect the island from erosion, and maintain structure for the expected lifespan of the project
Plant 4 island acres with native scrub-shrub vegetation	Enhanced scrub-shrub habitat provides nesting for colonial waterbirds (wading birds)
Smith Point Island (Galveston Bay)	
Construct 6 island acres by placing clean fill over submerged land	Constructed rookery island acres restores nesting habitat for colonial waterbirds
Enhance 2,000 feet of existing breakwater	Breakwaters contain island material, protect the island from erosion, and maintain structure for the expected lifespan of the project
Construct 250 feet of new breakwater	
Raise the elevation to build 2 acres of shell beach	Shell beach provides nesting habitat for colonial waterbirds
Plant 3 island acres with native scrub-shrub vegetation	Enhanced scrub-shrub habitat provides nesting for colonial waterbirds (wading birds)
Dressing Point Island (East Matagorda Bay)	
Construct 5 island acres by placing clean fill over	Constructed rookery island acres restores nesting habitat for

RESTORATION AND PROTECTION ACTIONS	RESTORATION OUTCOME
submerged land and raise the elevation on 2 acres of existing island	colonial waterbirds
Construct 5,000 feet of new breakwater	Breakwaters protect the island from erosion, and maintain structure for the expected lifespan of the project
Raise the elevation of an existing shell knoll to build 0.35 acres emergent shell hash	Shell hash knoll provides nesting habitat for colonial waterbirds
Plant 7 island acres with native scrub-shrub vegetation	Enhanced scrub-shrub habitat provides nesting for colonial waterbirds (wading birds)

2.1 Description of the Texas Rookery Islands

The Texas Rookery Islands project consists of four rookery islands (Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point). Within the remainder of this section, there is a subsection that provides a general description of each of the project's four islands with relevant background information.

2.1.1 Dickinson Bay Island II

Dickinson Bay Island II and III are currently in the preliminary engineering design stage. The Dickinson Bay Bird Nesting Islands Alternatives Analysis (Alternatives Analysis) was completed in 2014 (HDR Engineering [HDR] 2014). The scope of the Alternatives Analysis was to create conceptual designs for two islands that would support shore nesting bird habit. Design criteria for the islands were established for the project sites and consisted of wind, wave, tide, and storm conditions. The document summarized survey, benthic, and initial geotechnical investigations performed under previous investigations. Additional geotechnical investigations were performed as part of the Alternatives Analysis, along with the summarization of meteorological and oceanographic conditions at the proposed sites. For this Early Restoration effort, the Trustees are targeting Dickinson Bay Island II for restoration. One of two potential sites under evaluation would be chosen for construction of Dickinson Bay Island II (**Figure 2**). Dickinson Bay Island III is not part of this proposed project and will not be discussed.

Figure 2. One of two potential sites would be chosen for construction of Dickinson Bay Island II.

After construction is completed, the island footprint would be approximately 4 acres. To accomplish this, armored and potentially temporary levees would be constructed to contain fill material. The restored island would be protected by approximately 2,000 feet of armored levees around three sides of its perimeter. The remaining open side of the island would be bounded by a submerged levee. About 3.5 acres of the restoration area would be planted with native scrub-shrub vegetation. The submerged levee incorporated into the design serves to create a water/shore interface that would facilitate the use of the island by avian species. The preliminary design is shown in Figure 3.

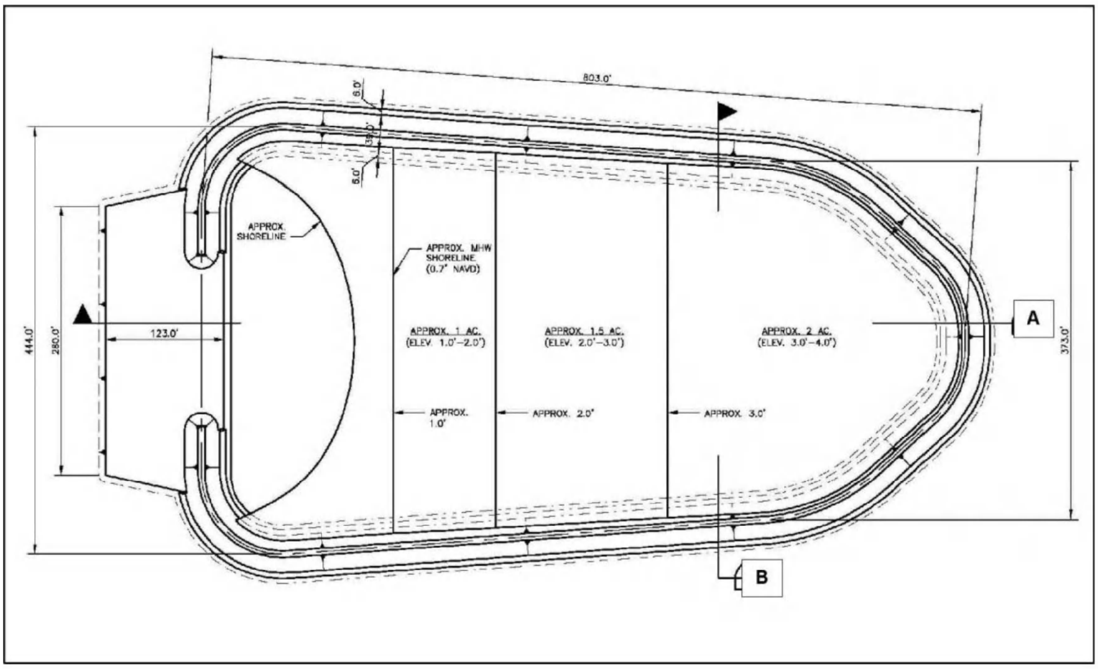

Figure 3. Preliminary design drawing of the proposed Dickinson Bay Island II restoration, showing the potential footprint of the fill material and armored levee.

Dickinson Bay Island II is under half of a mile from the mainland and is located at the mouth of Dickinson Bay in Galveston Bay, Galveston County, Texas. Specifically it is located in Dickinson Bay near 29.464394˚ N, 94.936601˚ W; NAD83. The area that may be directly or indirectly affected is about 15 acres and includes the footprint of the construction and staging areas around the island, breakwater, armored levee, or other structure, vegetation plantings, and earthen fill. The borrow area is not included in this footprint estimate because it has not yet been identified. A navigation channel, approximately 10 feet deep is located between the two potential project sites. Areas not within the navigation channel are approximately 3 to 4 feet deep. The nearby boat dock at April Fool Point, which is approximately 1 mile away, may be used to load and transport materials. The Texas General Land Office (TGLO) has identified places to access coastal waterways at http://www.glo.texas.gov/texas-beach-access/beach_bay.html. Information specific to Galveston County access points and available activities is located at http://www.glo.texas.gov/texas-beach-access/pdf/beach-bay/Galveston.pdf.

Dickinson Bay Island II would be built over submerged sediments in subtidal habitat. Sediment cores were taken and the substrate was analyzed. The substrate was defined as sandy lean clay with shell fragments or clayey sand with shell fragments. Detailed substrate profiles are in Appendix A of the Alternatives Analysis (GBF 2014). A navigation channel, approximately 10 feet deep is located between the two potential project sites. Areas not within the navigation channel are approximately 3-4 feet deep.

2.1.2 Rollover Bay Island

Rollover Bay Island is located north of the Gulf Intracoastal Waterway (GIWW) within Rollover Bay, a sub-bay of East (Galveston) Bay near Rollover Pass. Specifically it is located in Rollover Bay which lies in East (Galveston) Bay at 29.521548˚ N, 94.505693˚ W; NAD83. Rollover Pass is a tidal connection from East Bay to the Gulf of Mexico. The natural pass was deepened and enlarged to enhance migration of fisheries resources between the bay and the Gulf. The engineering design phase of the island would evaluate tidal actions in the area to ensure that forces associated with tropical storms, the East Bay fetch, GIWW traffic, and Rollover Pass are considered, as well as methods to protect to the island from land loss associated with predicted relative sea level rise. Restoration and protection measures would also restore the island's size and elevation such that it would provide sufficient area and height to support colonial nesting birds.

Rollover Bay Island was created through the placement of dredge material. Erosive forces have winnowed the lighter sediment and concentrated fossil mollusk shell and shell fragments leaving a surface layer of hard shell substrate. This shell material is not part of accreting reefs dominated by living eastern oysters and does not have commercial fisheries value; however, the shell reef is an important ecological habitat in Galveston Bay.

After construction is completed, the island footprint would be approximately 10 acres. To accomplish this, armored and potentially temporary levees would be constructed to contain clean fill material. The restored island would be protected by approximately 4,500 feet of armored levees along its vulnerable sides. About 4 acres of the restoration area would be planted with native scrub-shrub vegetation. The island would be sloped into the tidal zones at both ends of the island to provide water access for juvenile colonial waterbirds. Restoration and protection of Rollover Bay Island requires the placement of material on the submerged bay bottom, which may impact hard shell substrate, a valued benthic substrate in Galveston Bay. Any impacts incurred after avoidance and minimization measures are taken would be fully mitigated by restoring an equal or greater amount of hard substrate. The conceptual drawing is shown in **Error! Reference source not found.**.

Figure 4. Conceptual drawing of the proposed Rollover Bay Island restoration, illustrating potential temporary access channels, the footprint of the breakwater/levee, fill, and vegetation planting area.

The area that may be directly or indirectly affected is about 25 acres and includes the footprint of the construction and staging areas around the island, breakwater, armored levee, or other structure, vegetation plantings, and earthen fill. The source of fill material is not included in this footprint estimate the specific source has not yet been identified. Sediments from a navigable waterway including those deposited in a USACE placement area, a direct dredge borrow area that would be about 562,500 square feet in area and no deeper than 5 feet below grade, or another upland source may be used as the source of fill material. The island is near the GIWW which has depth of about 10 feet. The surrounding area is around 5 feet deep. The nearby boat dock at Dr. Lloyd K. Lauderdale Public Boat Ramp, which is about a half mile away, may be used to load and transport materials with small motorboats. Large equipment and materials moved by barges or other vessels would use the established interconnected waterways and larger commercial docking facilities. TGLO has identified places to access to coastal waterways at http://www.glo.texas.gov/texas-beach-access/beach_bay.html. Information specific to Galveston County access points and available activities is located at http://www.glo.texas.gov/texas-beach-access/pdf/beach-bay/Galveston.pdf.

2.1.3 Smith Point Island

Smith Point Island is located just west of the Smith Point peninsula that reaches into Galveston Bay between Trinity Bay and East Bay. Smith Point Island lies approximately 1.25 miles southwest of the Smith Point peninsula and is approximately 1.4 miles from the James Robbins Park boat ramp on the peninsula. The island is located between Trinity Bay and East Bay within Galveston Bay near 29.5363˚ N, 94.8087˚ W; NAD83. The island is currently composed of winnowed oyster shell and shell hash that was left behind after the lighter dredged sediments eroded away with little surface soils present. The shell is constantly moved by wave energy which inhibits the accumulation of soil or fine shell material capable of supporting vegetation. The submerged bay bottom surrounding the island is primarily composed of clays with some silt. The area contains considerable active oyster reef, oyster leases, and hard bottom substrate (**Error! Reference source not found.**).

After construction is completed, the island footprint would be approximately 6 acres. Temporary levees may be constructed to contain fill material. The restored island would be protected by approximately 250 feet of new breakwater and 2,000 feet of existing breakwater around three sides of its perimeter. The southern portion (2 acres) of the existing island would be improved by raising the elevation with shell material to build an emergent shell beach. About 3 acres of the restoration area would be planted with native scrub-shrub vegetation. The conceptual drawing is shown in Figure 5.

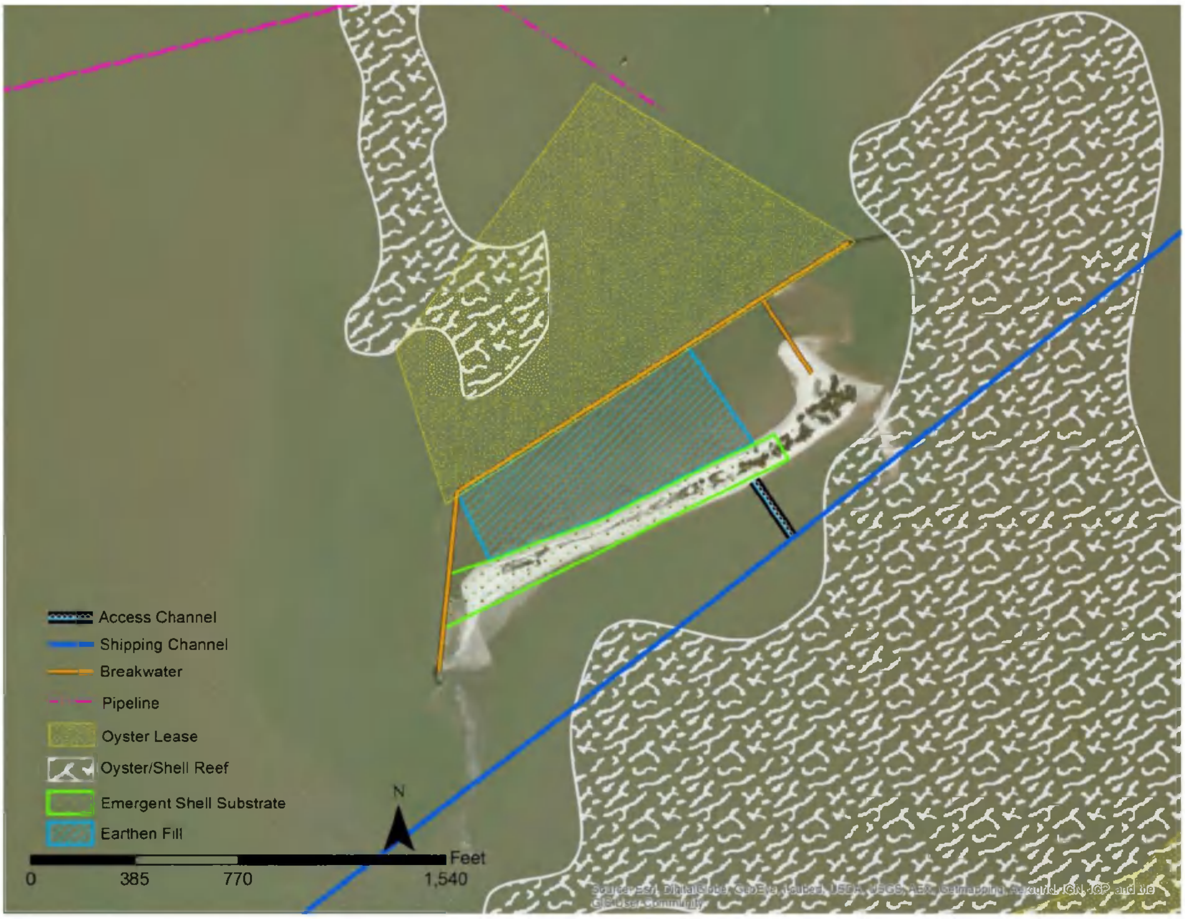

Figure 5. Conceptual drawing of Smith Point Island restoration, illustrating a potential temporary access channel, the footprint of the breakwater, fill, potential access channel, emergent shell substrate, and oyster reef.

The area that may be directly or indirectly affected is about 28 acres and includes the footprint of the construction and staging areas around the island, breakwater, armored levee, or other structure, vegetation plantings, earthen fill, and emergent shell substrate. The source of fill material is not included in this footprint estimate the specific source has not yet been identified. Sediments from a navigable waterway including those deposited in a USACE placement area, a direct dredge borrow area that would be about 562,500 square feet in area and no deeper than 5 feet below grade, or another upland source may be used as the source of fill material. The depths near the island are relatively shallow ranging to a depth of approximately 3 feet in the surrounding area and up to 5 feet in the adjacent navigation channel. The nearest dock to the project site is located on Smith Point peninsula and may be used to load material for transport to the project area. The site can be accessed using the Channel to Smith Point which connects Smith Point to the Houston Ship Channel (National Oceanic and Atmospheric Administration [NOAA] navigational charts for Galveston/Houston: http://xpda.com/nauticalcharts/).

2.1.4 Dressing Point Island

Dressing Point Island is located in East Matagorda Bay, Matagorda County, Texas at 28.731386˚ N, 95.7606712˚ W; NAD83. It is part of the Big Boggy National Wildlife Refuge and is located 8 miles east of the community of Matagorda and 21 miles southeast of Bay City (**Error! Reference source not found.**). Dressing Point Island currently includes 7 acres of vegetated island and intertidal shell beach as well as shell hash berms along parts of its shoreline. The area that may be directly or indirectly affected is about 56 acres and includes the footprints of the construction and staging areas around the island, breakwater/levee, vegetation plantings, earthen fill, and shell knoll. The source of fill material is not included in this footprint estimate the specific source has not yet been identified. Sediments from a navigable waterway including those deposited in a USACE placement area, a direct dredge borrow area that would be about 562,500 square feet in area and no deeper than 5 feet below grade, or another upland source may be used as the source of fill material. Materials for the construction activities would need to be transported via roads and via marine waterways. Existing transportation networks and navigational channels would be utilized as much as possible. Large-scale equipment and supplies may enter East Matagorda Bay via the GIWW. Small boats could enter the bay via boat ramps from the community of Chinquapin, approximately 1.5 miles from Dressing Point Island.

After construction is completed, the island footprint would be approximately 12 acres, which includes about 5 acres of existing island that would be avoided during construction. Fill would be placed on 2 acres of existing island and on 5 acres on submerged lands between the constructed breakwater and existing island. Temporary berms would be constructed, if needed, to contain fill material. The restored island would be protected by approximately 5,000 feet of breakwater. About 7 acres of the restoration area would be planted with native scrub-shrub vegetation. Approximately 2,500 cubic yards of shell material would be placed and integrated with the existing shell knoll (emergent shell substrate) southwest of the island. This added material would raise the elevation to support ground nesting species of colonial waterbirds. It would also provide a small wave break and protect a portion of the island from wave induced erosion. The conceptual drawing is shown in Figure 6.

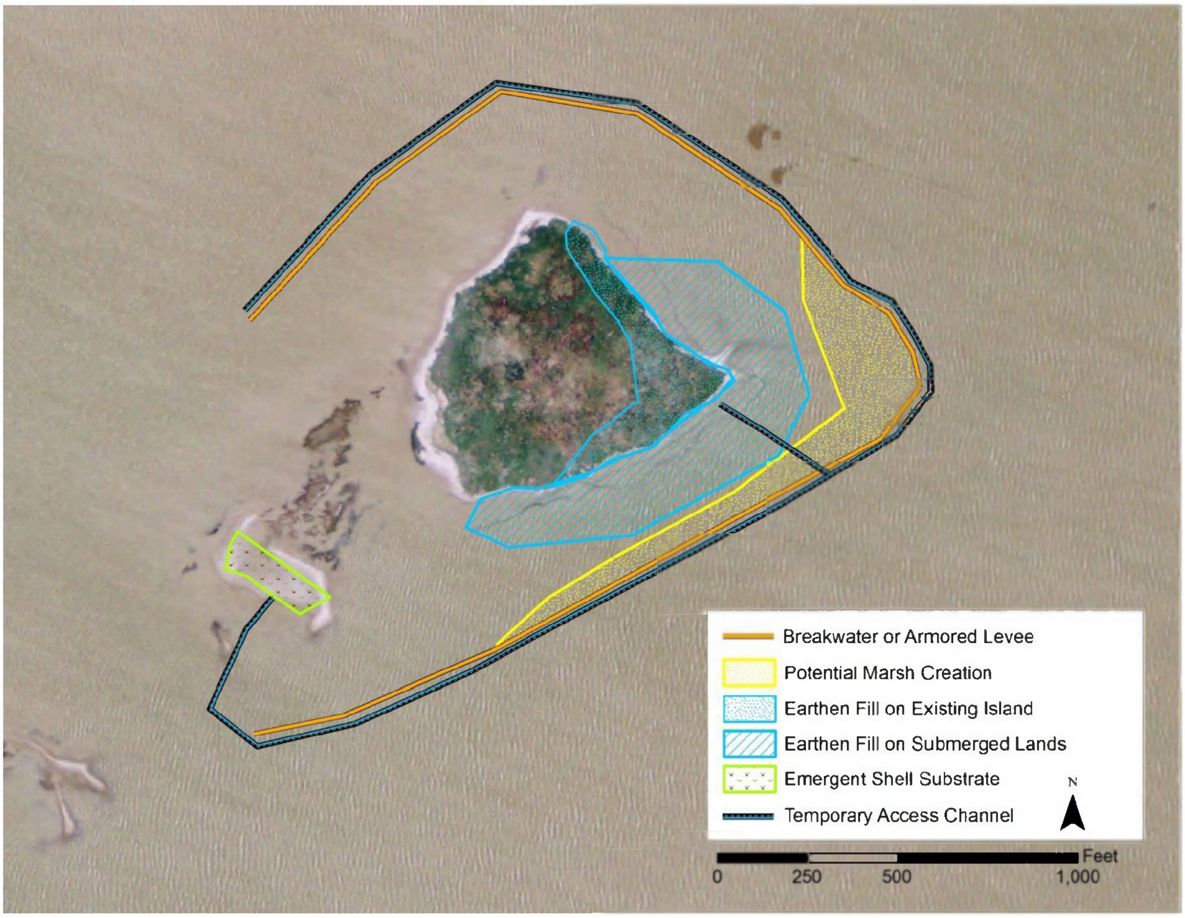

Figure 6. Conceptual drawing of the proposed Dressing Point Island restoration, illustrating the footprint of the breakwater/levee, fill, and emergent shell substrate.

A shell knoll southwest of the island has some scattered winnowed oyster shell (fossil). These areas have been surveyed, identified and mapped. The shell is constantly moved by wave energy which prevents the accumulation of soil or fine shell material capable of supporting vegetation. To enhance the existing shell knoll, material consistent in structure and composition would be placed southwest of the island to increase the elevation.

A potential component of the restoration and protection of Dressing Point Island includes a constructed marsh located adjacent to the breakwater. Should dredging be required to provide access for vessels during construction, the project design would allow for the beneficial use of the dredge material, using best management practices (BMPs), to backfill the channel and use any excess material to create intertidal marsh. The decision to construct the marsh would be made by the Implementing Trustees[1] for

[1] U.S. Department of the Interior and the Texas Trustees (Texas Commission on Environmental Quality, Texas General Land Office, and Texas Parks and Wildlife Department).

the Texas Rookery Islands project and only after it has been determined that there are enough remaining funds available from the Texas Rookery Islands project.

2.2 Texas Rookery Island Construction and Installation

Construction and implementation strategies would be similar for each rookery island.

2.2.1 Best Management Practices

Throughout the design process, every practical attempt would be made to avoid and minimize potentially adverse environmental and cultural impacts. The best management practices (BMPs) and conservation measures that would be utilized to minimize impacts to resources are listed in Section 5.

2.2.2 Island Fill and Borrow Site

Uncontaminated earthen fill material would be used to raise elevations. Fill material would be sourced from a navigable waterway including sediments deposited in a USACE placement area, a direct dredge borrow area that would be about 562,500 square feet in area and no deeper than 5 feet below grade, or another upland source may be used as the source of fill material. Sediments determined to be suitable from an engineering perspective would be evaluated for environmental conditions to ensure that any cultural and/or sensitive resources are properly addressed. The location chosen would be based on several factors including the absence of sensitive resources (e.g. oyster reef, seagrasses), geotechnical and sediment quality, nearby commercial and/or recreational activities, and lateral extent of available material (avoiding a deep borrow site). The site would have an optimal footprint in order to keep the depth modified by the removal of material as shallow as possible, which would prevent impacts to water quality, scouring, or the development of deep pockets in a naturally shallow bay system. Ideally, the borrow site would be situated in the bay to receive sediments carried by currents so it can be replenished with sediments quickly, increasing the rate of recovery to the level of the adjacent bay bottom.

For any of these borrow sites, the material would be mixed with water, requiring a settlement period and the controlled discharge of decant water from within the placement area. The height of any temporary or permanent structure and construction methods required to contain the earthen fill would be determined by the type of material used and its estimated water content. Location of the structures would ensure containment and settlement of the fill materials, using BMPs. The volume of earthen fill material for each island is listed below and is the maximum amount of material estimated to be needed:

- Dickinson Bay Island II – 76,000 cubic yards
- Rollover Bay Island – 80,000 cubic yards
- Smith Point Island – 70,000 cubic yards
- Dressing Point Island – 50,000 cubic yards

The areas identified on Figures 7 and 8 identified as direct dredge source areas have a larger footprint than what will be needed for this project. The actual site chosen within the direct dredge source area will be about 562,500 square feet in area and no deeper than 5 feet below grade. The direct dredge source area that would be used for Rollover Bay Island is about 77 acres, Smith Point Island is about 703 acres, Dickinson Bay II is about 76 acres, and for Dressing Point Island it is about 259 acres.

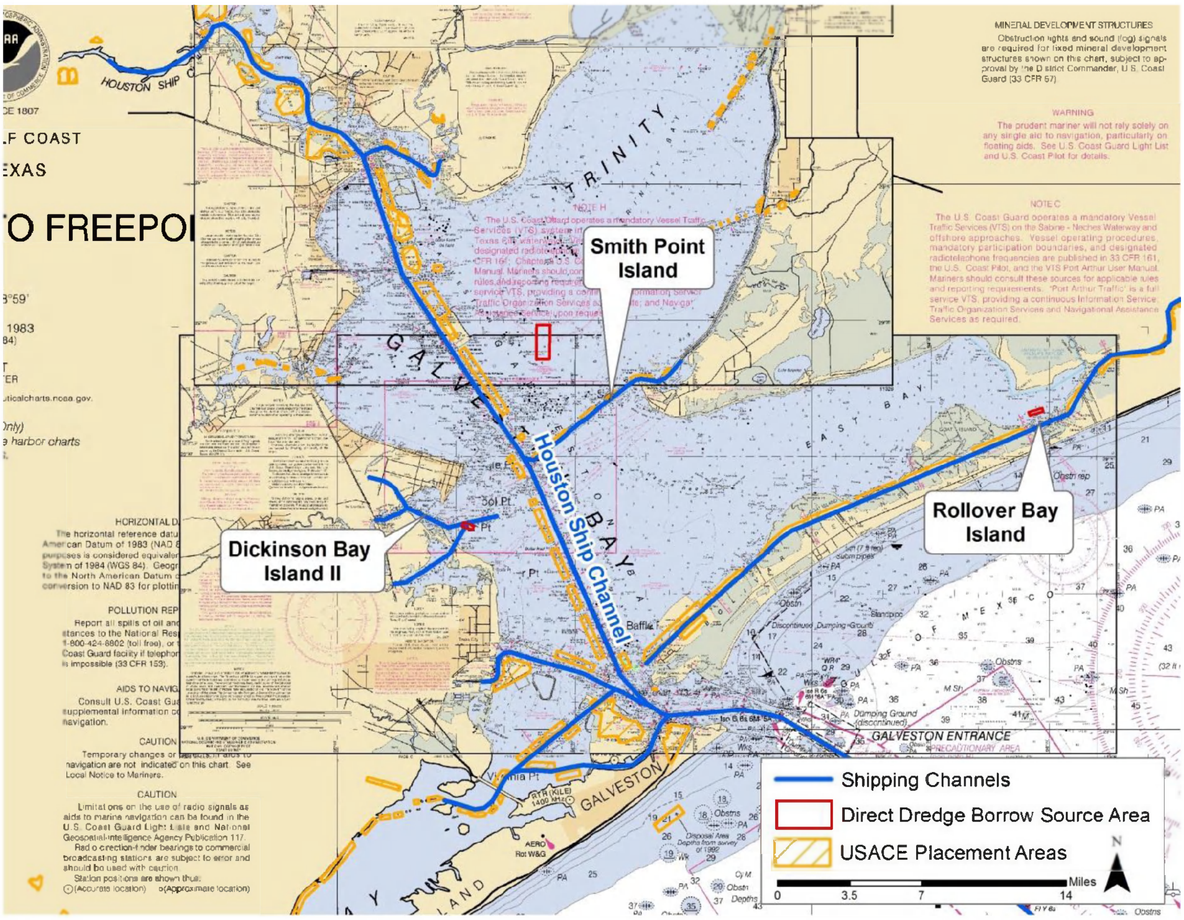

Figure 7. Location of potential sites (i.e. shipping channels, direct dredge borrow source area, and USACE placement areas) that could be mined for fill material in Galveston Bay.

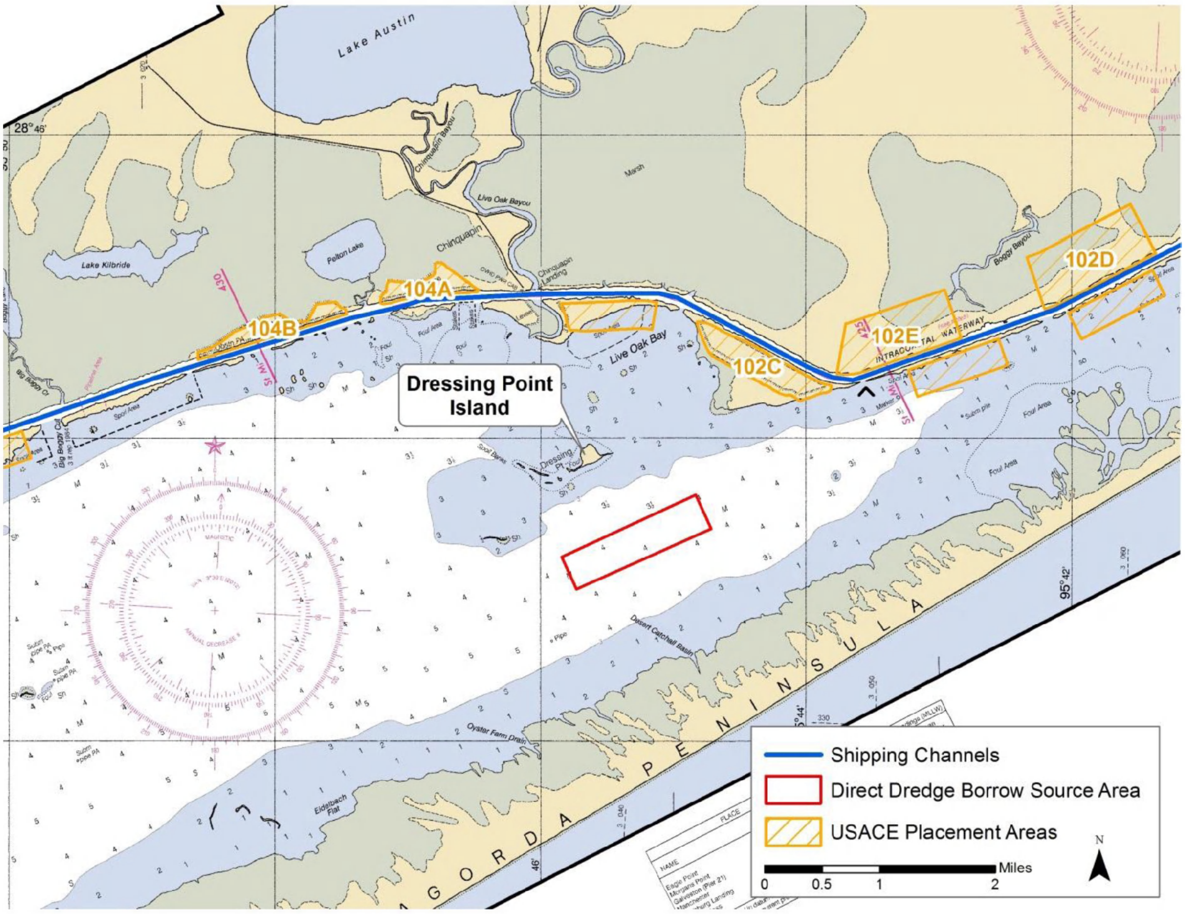

Figure 8. Location of potential sites (i.e. shipping channels, direct dredge borrow source area, and USACE placement areas) that could be mined for fill material in East Matagorda Bay. Placement areas currently being considered are labeled.

Material from a direct dredge source area would be mechanically excavated or hydraulically dredged. Excavators used may include a dragline or long-arm excavator to place material on barges for transport to the island site. Hydraulic dredge would be a cutter-head design because it does not pose a risk to pelagic aquatic organisms. If hydraulic dredging is used, the dredge pipe will avoid disturbance to sensitive resource areas such as oyster reefs and seagrass beds. The pipe would be routed to avoid laying on top of these resource areas and any equipment will avoid them as well. Any areas containing such resources in the construction and transport area of each project site will be visibly marked prior to start of construction. Material would be transported to the island via a hydraulic dredge pipeline or by barge if a mechanical dredge is used. Pipeline or hydraulic dredges, because they are not known to take sea turtles, will be used, if possible (NOAA 2007).

A form or method of beneficial use of dredged material is to mine existing USACE material placement areas (PA) that are associated with federally maintained navigation channels. These PAs are maintained and operated as part of the GIWW federal project. Material would be mined using mechanical or hydraulic excavation techniques. Mechanically excavated material would be placed on barges and transported to the island site using ingress and egress routes depicted in Figures 7 and 8.

There are no known contaminants associated with the direct dredge borrow source areas identified. Screening for potential chemical contaminants will be conducted on a case-by-case basis. For sediments from federally-maintained navigation channels or associated dredged material placement areas, previously collected contaminant analysis and bio-assay data will be obtained from the USACE Galveston District - Operations Branch records.

For bay bottom borrow sites, local and regional knowledge of historical industrial activities as well as regulatory documentation on past and existing facilities in the vicinity of potential sediment borrow sources will be used to determine the likelihood and type of contaminants that might be expected to be encountered during construction. Based upon this information, USACE and state and federal resource agency personnel will be consulted to determine the amount of sampling and the type of chemical analyses that may be needed.

2.2.3 Breakwater/Armored Levee

Breakwaters or armored levees would be installed to protect the island from erosional forces. However, they could be modified or enhanced as part of this project to act as containment for the earthen fill. Graded stone, typically limestone, would be used to construct the breakwaters or armoring. The amount, grading, and size of rock used would be dependent on several factors determined in the final design. These include wave and current energy expected, as well as whether the breakwaters or armored levees would be used for containment and dewatering of sediments or only for erosion protection. Breakwaters and levees used for containment are typically higher in elevation and larger than those used solely for erosion protection. These considerations along with physical data from the site would be evaluated by a qualified coastal PE and the project team prior to selection of design. The project team would include individuals from TPWD, USFWS, and participating partners. The source of the material is expected to be from known and existing limestone quarries used for coastal construction projects across the western Gulf of Mexico meeting standards specified for the project.

2.2.4 Submerged Levee

Only Dickinson Bay Island II would have a submerged levee as part of its design. The submerged levee incorporated into the design serves to create a water/shore interface that would facilitate the use of the island by avian species. The calm water/shore interface is an important component used by nesting birds and their fledged young. The exact design specifications have yet to be determined by the project team. However, a cap of protective cultch or rock material would be deployed over the submerged levee to provide long-term protection. The submerged levee may be exposed during low tide events but its elevation would be within the normal intertidal range.

2.2.5 Vegetation Planting

Once the earthen fill has dewatered and sediments have settled, the higher elevation portions of the restored islands would be planted with native scrub-shrub vegetation to help promote desired vegetation establishment. Each island site would have a targeted number of acres for vegetative plantings: Dickinson Bay Island II, 3.5 acres; Smith Point Island, 3 acres; and Rollover Bay Island, 4 acres. Plants used would be species documented from similar island sites and be propagated from stock located on the upper Texas coast. Species under consideration include, but are not limited to, those shown in Table 2. Additionally, marsh plantings, if required, would include smooth cordgrass (*Spartina alterniflora*) and with marshhay cordgrass (*Spartina patens*). A Vegetation Planting Plan modified from and based on the Natural Resources Conservation Service (NRCS) Publication NRCS-TX-612 would be developed prior to implementation (NRCS 2013). This plan would provide specifications for the species of native vegetation to be used; acceptable source stock; planting densities and locations on the island for planting; survival targets and adaptive management strategies. Expected plant survival is approximately 60% at the end of the 5-year monitoring period. Protective measures may include trunk collars or wire exclusion cages to protect saplings from herbivory or trampling during the first few years after planting. Time of year as well as substrate salinity would determine the timing for planting. It is anticipated that this would take place approximately one year after construction, depending on environmental conditions.

Table 2. Examples of native scrub-shrub species proposed for transplanting

Common Name	Scientific Name
Colima	*Zanthoxylum fagara*
Woolybucket Bumelia	*Bumelia lanuginosa*
Prickly Pear Cactus	*Opuntia dilleni*
Desert Olive	*Forestiera augusifolia*
Huisache	*Acacia famesiana*
Jerusalem Thorn	*Parkinsonia aculeate*

2.2.6 Shell Beach Enhancement

Shell beach habitat on Smith Point Island would be enhanced to support ground nesting birds by placing material similar to the existing shell hash on top of the existing substrate. Approximately 5,000 cubic yards of material similar to the existing shell is anticipated to be deposited on Smith Point Island raising the elevation approximately 1.5 feet. The final elevation of the improved island would be such that it would be suitable for shell and bare ground nesting species. The wave energy would maintain a portion of the island free from vegetation and ideal for shell and bare ground nesting birds.

Rollover Bay Island was created through the placement of dredge material. Erosive forces have winnowed the lighter sediment and concentrated fossil mollusk shell and shell fragments leaving a surface layer of hard shell substrate. This shell material is not part of accreting reefs dominated by living eastern oysters and does not have commercial fisheries value; however, the shell reef is an important ecological habitat in Galveston Bay. Therefore any unavoidable impacts to hard shell substrate caused by the placement of material for the island restoration may require mitigation.

Material placed onto Rollover Bay and Smith Point Islands would be added in a manner that it emulates shell berms observed in nearby areas. The source of this material would be similar to the shell hash present on these islands in structure, form, and mineral composition (calcareous) and be either from current shell sources, limestone, or a mixture of limestone and shell, or material similar in size shape, density, etc. This material would be obtained from commercially available sources.

2.2.7 Shell Knoll Enhancement

To enhance habitat for bare ground nesting birds near Dressing Point Island, shell material would be placed and integrated with the existing shell knoll (emergent shell substrate) southwest of the island. Approximately 2,500 cubic yards of shell material similar to the shell hash present in structure, form, and mineral composition (calcareous) would be placed on the knoll. This added material would raise the elevation to support ground nesting species of colonial waterbirds. It would also provide a small wave break and protect a portion of the island from wave induced erosion.

2.2.8 Construction Schedule

Currently the Dickinson Bay Island II does not exist; therefore, there is no nesting habitat present and construction could occur anytime during the year. If it appears that birds will nest on Rollover Bay and Smith Point Islands, construction would avoid the nesting season, which is usually February 1 through August 15. Dressing Point Island is currently used for nesting by waterbirds. Therefore, construction activities would avoid the nesting season, which is usually February 1 through August 15. However, some field activities may be acceptable that cause limited disturbance to birds that are nesting. Any such activities would be coordinated with state and federal agency biologists and with non-governmental organization (NGO) partners prior to initiation of field work. The final engineering and design for all the islands is estimated to be completed in 18 months. Activities associated with construction are not expected to take longer than 6 months for Smith Point and Dressing Point Islands and 12 months for Dickinson Bay II and Rollover Bay Islands. The timing of contracting awards and weather conditions could impact the construction schedule. To prevent disturbance to nearby residential communities near Rollover and Smith Point, construction activities that produce significant noise or require precision, such as moving or placing rock would be limited to daylight hours.

2.2.9 Operations and Maintenance

The Galveston Bay Foundation leases a previously restored island in Dickinson Bay from the TGLO. Audubon Texas manages Rollover Bay Island through a lease for the island and submerged lands with the TGLO and Smith Point Island through a lease for the island and submerged lands with the Chambers-Liberty Navigation District. Any additional lease(s) for managing the submerged bay bottom and the construction activities would be obtained prior to implementing the proposed restoration. Maintenance activities on Dickinson Bay Island II would likely be managed by the Galveston Bay Foundation or another stakeholder and maintenance at Smith Point and Rollover Bay Islands would likely be managed by Audubon Texas or another stakeholder. As members of the Texas Colonial Waterbird Society, they participate in the annual waterbird surveys and work collectively to support waterbird conservation.

As members of the project teams for the respective islands, both Galveston Bay Foundation and Audubon Texas would participate in project development and be cognizant of obligations related to long-term management. Activities on the islands by both organizations include monitoring, predator control, and educational signs to reduce disturbance.

Dressing Point Island is part of the Big Boggy National Wildlife Refuge. It was donated and added to the refuge system in 1988, and is now part of the USFWS' Texas Mid-Coast Refuge Complex. The island is an uninhabited and not open to the public but open water areas of the bay are used for commercial or recreational activities such as paddling, fishing, wildlife viewing, or transportation. As part of the Big Boggy National Wildlife Refuge, maintenance activities on Dressing Point Island would continue to be managed by the USFWS. Annual surveys colonial waterbirds surveys are conducted and submitted for collection. Routine assessment of the island is made by refuge biologists and managers. Once construction specifications and deliverables have been achieved, routine management would be the responsibility of refuge personnel.

2.2.10 Monitor & Adaptively Manage Structure

Monitoring would be conducted before, during, and after project implementation to ensure compliance with project design and completion. If immediate post-construction monitoring reveals that unavoidable impacts to EFH have occurred, appropriate coordination with regional EFH personnel would take place to determine appropriate response measures, possibly including mitigation. If additional adaptive management of the islands is necessary after monitoring events, all minimization measures discussed above would be followed.

3 ESSENTIAL FISH HABITAT

The 1996 amendments to the Magnuson-Stevens Act set forth a mandate for NMFS, regional Fishery Management Councils (FMC), and other Federal agencies to identify and protect EFH of economically important marine and estuarine fisheries. To achieve this goal, suitable fishery habitats need to be maintained. EFH is separated into estuarine habitat types. Estuarine habitat is defined as "all estuarine waters and substrates (mud, sand, shell, rock and associated biological communities), including the sub-tidal vegetation (grasses and algae) and adjacent inter-tidal vegetation (marshes and mangroves)." EFH in the area of proposed action is identified and described for various life stages of managed fish and shellfish in the Gulf of Mexico (Gulf of Mexico FMC [GMFMC] 1998). A provision of the Magnuson-Stevens Act requires that FMC's identify and protect EFH for every species managed by a Fishery Management Plan (FMP) (U.S.C. 1853(a)(7)). There are FMP's in the Gulf region for red drum, shrimp, reef fish, and highly migratory species (e.g., sharks). **Error! Reference source not found.** and **Error! Reference source not found.** present the EFH and species within the Texas Rookery Islands project area.

Table 1. EFH for estuarine habitats within the project area for the Texas Rookery Islands

Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Estuarine Emergent Marsh							
Red Drum			●	●	●	●	
Gray Snapper						●	
Brown Shrimp				●			
White Shrimp				●			
Estuarine Oyster Reef							

Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Brown Shrimp				●			
Estuarine Sand and Shell Bottom							
Red Drum			●		●	●	
Gray Snapper						●	
Lane Snapper				●	●		
Brown Shrimp				●			
Estuarine Mud/Soft Bottom							
Red Drum		●	●	●	●	●	
Gray Snapper						●	
Lane Snapper				●	●		
Brown Shrimp				●			
White Shrimp				●			

(● indicates habitat type designated as EFH for species' life stage)

Table 2. Highly migratory species EFH designations within project area for the Texas Rookery Islands

Species Common Name	Life Stage Within Estuarine Waters
Scalloped Hammerhead Shark	Neonate & Juvenile
Blacktip Shark	Neonate, Juvenile & Adult
Bull Shark	Neonate, Juvenile & Adult
Lemon Shark	Neonate (Dickinson Bay II, Rollover Bay, Smith Point Islands only) Juvenile (Dressing Point Island only)
Spinner Shark	Neonate & Juvenile
Bonnethead Shark	Neonate, Juvenile & Adult
Atlantic Sharpnose Shark	Neonate, Juvenile & Adult
Finetooth Shark	Neonate (Dressing Point Island only)

3.1 EFH for MANAGED FISH SPECIES

The seasonal and year-round locations of designated EFH for the managed fisheries are depicted on the figures available on the NMFS website (http://sero.nmfs.noaa.gov/hcd/efh.htm) and species abundance maps, both inshore and offshore, are available on the National Ocean Service (NOS) website (http://ccma.nos.noaa.gov/products/biogeography/gom-efh/). EFH figures for highly migratory species (HMS) are found in the 2009 amendments to the Consolidated Atlantic Highly Migratory Species Fisheries Management Plan (http://www.nmfs.noaa.gov/sfa/hms/documents/fmp/am1/feis/feis_amendment_1_chapter5.pdf). The EFH for each of the relevant management units (red drum, shrimp, reef fish, and highly migratory species) is described below:

3.1.1 Red Drum

EFH for red drum consists of all Gulf of Mexico estuaries; waters and substrates extending from Vermilion Bay, Louisiana to the eastern edge of Mobile Bay, Alabama out to depths of 25 fathoms; waters and substrates extending from Crystal River, Florida to Naples, Florida between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms (GMFMC 2010).

Types of estuarine habitats could include: tidal freshwater, estuarine emergent vegetated wetlands (flooded saltmarshes, brackish marsh, tidal creeks), estuarine scrub/shrub (mangrove fringe), sea grasses, oyster reefs and shell banks; and unconsolidated bottom (soft sediments).

3.1.2 Shrimp

EFH for shrimp consists of Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Fort Walton Beach, Florida from estuarine waters out to depths of 600 feet (100 fathoms); waters and substrates extending from Grand Isle, Louisiana to Pensacola Bay, Florida between depths of 600 and 1,950 feet (100 and 325 fathoms); waters and substrates extending from Pensacola Bay, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 210 feet (35 fathoms), with the exception of waters extending from Crystal River, Florida to Naples, Florida between depths of 60 and 150 feet (10 and 25 fathoms) and in Florida Bay between depths of 30 and 60 feet (5 and 10 fathoms) (GMFMC 2010).

Brown shrimp are found within the estuaries to offshore depths of approximately 360 feet throughout the Gulf; white shrimp inhabit estuaries and to depths of about 131 feet offshore in the coastal area extending from Florida's Big Bend area through Texas. Brown and white shrimp are generally more abundant in the central and western Gulf, whereas pink shrimp are generally more abundant in the eastern Gulf (GFMFC 2006).

3.1.3 Reef Fish

EFH for reef fish consists of all estuaries as well as Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 600 feet (100 fathoms) (GMFMC 2010).

3.1.4 Highly Migratory Species

Shark habitat can be described in four broad categories: (1) coastal, (2) pelagic, (3) coastal-pelagic, and (4) deep-dwelling. Coastal species inhabit estuaries, the nearshore and waters of the continental shelves, e.g., blacktip, finetooth, bull, lemon, and sharpnose sharks. Coastal-pelagic species are intermediate in that they occur both inshore and beyond the continental shelves, but have not demonstrated mid-ocean or transoceanic movements (GFMFC 2006).

HMS utilizes diverse habitats that have been identified as essential to various life stages. Many of the shark species use bays, estuaries and shallow coastal areas as crucial pupping and nursery areas (NMFS 2006). In most cases the neonates (newborn) and juveniles occupy different habitats than the adults. For example, neonate blacktip sharks are found in very shallow waters, juvenile blacktip sharks inhabit a variety of coastal habitats, and adults are found in both coastal and oceanic waters (NMFS 2006).

Due to habitat specific requirements of each species, EFH for each HMS potentially occurring in the vicinity of the Texas Rookery Islands project is described below (EFH information from NMFS 2009).

EFH for Scalloped Hammerhead Shark:

- Neonate/young-of-the-year (YOY) (≤60 cm total length): Coastal areas in the Gulf of Mexico from Texas to the southern west coast of Florida. Atlantic east coast from the mid-east coast of Florida to southern North Carolina.
- Juveniles (61 to 179 cm total length): Coastal areas in the Gulf of Mexico from the southern to mid-coast of Texas, eastern Louisiana to the southern west coast of Florida, and the Florida Keys. Offshore from the mid-coast of Texas to eastern Louisiana. Atlantic east coast of Florida through New Jersey.
- Adults (≥180 cm total length): Coastal areas in the Gulf of Mexico along the southern Texas coast, and eastern Louisiana through the Florida Keys. Offshore from southern Texas to eastern Louisiana. Atlantic east coast of Florida to Long Island, NY.

EFH for Blacktip Shark:

- Neonate/YOY (≤75 cm total length): Coastal areas in the Gulf of Mexico from Texas through the Florida Keys. In Atlantic coastal areas from northern Florida through Georgia, and the mid-coast of South Carolina.
- Juvenile (76 to 136 cm total length): Coastal areas in the Gulf of Mexico from Texas through the Florida Keys. In Atlantic coastal areas localized off of the southeast Florida coast and from West Palm Beach, Florida to Cape Hatteras.
- Adult (≥137 cm total length): Coastal areas in the Gulf of Mexico from Texas through the Florida Keys. In Atlantic coastal areas southeast Florida to Cape Hatteras.

EFH for Bull Shark:

- Neonate/YOY (≤95 cm total length): Gulf of Mexico coastal areas along Texas, and localized areas off of Mississippi, the Florida Panhandle, and west coast of Florida; as well as the Atlantic mid-east coast of Florida.
- Juveniles (96 to 219 cm total length): Gulf of Mexico coastal areas along the Texas coast, eastern Louisiana to the Florida Panhandle, and the west coast of Florida through the Florida Keys. Atlantic coastal areas localized from the mid-east coast of Florida to South Carolina.
- Adults (≥220 cm total length): Gulf of Mexico along the southern and mid-coast of Texas to western Louisiana, eastern Louisiana to the Florida Keys. East coast of Florida to South Carolina in the Atlantic.

EFH for Lemon Shark:

- Neonate/YOY (≤86cm total length): Gulf of Mexico coastal areas along the Texas midcoast and the Florida Keys, and a localized area on the mid-west coast of Florida. Puerto Rico and Virgin Islands.
- Juveniles (87 to 239 cm total length): Gulf of Mexico coastal areas along Texas, eastern Louisiana, and the Florida Panhandle through the Florida Keys. Coastal areas along the Atlantic east coast of Florida. Puerto Rico and Virgin Islands.
- Adults (≥240 cm total length): Gulf of Mexico coastal areas along the west coast of Florida through the Florida Keys. Localized coastal areas along the southern and northern east coast of Florida in the Atlantic.

EFH for Spinner Shark:

- Neonate/YOY (≤70 cm total length): Localized coastal areas in the Gulf of Mexico along Texas, eastern Louisiana, the Florida Panhandle, Florida west coast, and the Florida Keys; and in the Atlantic along the east coast of Florida to southern North Carolina.
- Juveniles (71 to 179 cm total length): Gulf of Mexico coastal areas from Texas to the Florida Panhandle, and the mid-west coast of Florida to the Florida Keys. Atlantic east coast of Florida through North Carolina.
- Adults (≥180 cm total length): Localized areas in the Gulf of Mexico off of southern Texas, Louisiana through the Florida Panhandle, and from the mid-coast of Florida through the Florida Keys. In the Atlantic along the east coast of Florida, and localized areas from South Carolina to Virginia.

EFH for Bonnethead Shark:

- Neonate/YOY (≤55 cm total length): Coastal areas in the Gulf of Mexico along Texas, and from eastern Mississippi through the Florida Keys. Atlantic east coast from the midcoast of Florida to South Carolina.
- Juveniles (56 to 81 cm total length): Coastal areas in the Gulf of Mexico along Texas, and from eastern Mississippi through the Florida Keys. Atlantic east coast from the midcoast of Florida to South Carolina.
- Adults (≥82 cm total length): Coastal areas in the Gulf of Mexico along Texas, and from eastern Mississippi through the Florida Keys. Atlantic east coast from the mid-coast of Florida to Cape Lookout.

EFH for Atlantic Sharpnose Shark:

- Neonate/YOY (≤60 cm total length): Gulf of Mexico coastal areas from Texas through the Florida Keys. In the Atlantic from the mid-coast of Florida to Cape Hatteras.

- Juveniles (61 to 71 cm total length): Gulf of Mexico coastal areas from Texas through the Florida Keys. In the Atlantic from the mid-coast of Florida to Cape Hatteras, and a localized area off of Delaware.
- Adults (≥72 cm total length): Gulf of Mexico from Texas through the Florida Keys out to a depth of 200 meters. In the Atlantic from the mid-coast of Florida to Maryland.

EFH for Finetooth Shark:

Note: At this time, insufficient data is available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages.

- Neonate/YOY (≤85 cm total length): Along the Gulf of Mexico coast of Texas, eastern Louisiana, Mississippi, Alabama, and the Florida Panhandle. Atlantic east coast along Georgia and South Carolina.
- Juvenile and Adult: EFH designation for juvenile and adult life stages have been combined and are considered the same. Localized coastal areas along southern Texas and Key West, Florida, and from eastern Louisiana through the Florida Panhandle in the Gulf of Mexico. Atlantic east coast from the mid-coast of Florida to Cape Hatteras.

3.2 ECOLOGICAL NOTES ON THE EFH FISHERIES AND SPECIES

The project components of proposed action are composed largely of estuarine shallow water and island habitat. Intertidal zones and subtidal zones near the construction areas are generally composed of soft bottom sediments and winnowed oyster shell. Although there have been some seagrass and oyster surveys in parts of the project area, updated surveys will be conducted to identify the extent of these resources. Seagrasses are known to be present in the Dressing Point Island project area and oysters are known to be present in the Rollover Bay Island, Dressing Point Island, and Smith Point Island project areas. To the extent possible, construction activities would avoid or minimize impacts to seagrasses and oysters. All provisions and mitigation measures of any federal permits and/or consultations will be followed. Benthic habitat including oysters and seagrasses support an array of neonate, juvenile, and adult fish.

3.2.1 Red Drum

In the Gulf of Mexico red drum occur in a variety of habitats, ranging from depths of about 130 feet offshore to very shallow estuarine waters. They commonly occur in virtually all of the Gulf's estuaries where they are found over a variety of substrates including sand, mud and oyster reefs. Red drum can tolerate salinities ranging from freshwater to highly saline (National Council for Agricultural Education 1995). Types of habitat occupied depend upon the life stage of the fish. Spawning occurs in deeper water near the mouths of bays and inlets, and on the Gulf side of the barrier islands (GMFMC 1998). The eggs hatch mainly in the Gulf, and larvae are transported into the estuary where the fish mature before moving back to the Gulf (GMFMC 1998). Adult red drum use estuaries but tend to spend more time offshore as they age.

Estuarine wetlands are especially important to larval, juvenile and subadult red drum. An abundance of juvenile red drum has been reported around the perimeter of marshes in estuaries. Young fish are found in quiet, shallow, protected waters with grassy or slightly muddy bottoms. Shallow bay bottoms or oyster reef substrates are especially preferred by subadult and adult red drum (GMFMC 1998).

Red drum EFH is common in the project area. The estuarine zone is used by this species in all life stages. Habitat use is highest for nearshore hard bottoms, nearshore sand/shell, seagrass, and estuarine soft bottoms (GMFMC 2005). Larvae, juveniles, and young adults spend the majority of their time in estuarine habitats and prey on a large array of species including plankton, blue crab, shrimp, and numerous juvenile fish (Overstreet and Heard 1978).

3.2.2 Shrimp

Shrimp use a variety of estuarine and marine habitats in the Gulf of Mexico. Brown shrimp are found within the estuaries to offshore depths of 361 feet (110 meters) throughout the Gulf; white shrimp inhabit estuaries and to depths of about 131 feet (40 meters) offshore in the coastal area extending from Florida's Big Bend area through Texas. Brown and white shrimp are generally more abundant in the central and western Gulf, whereas pink shrimp are generally more abundant in the eastern Gulf.

Brown Shrimp

Brown shrimp range in the Gulf of Mexico from Florida to the northwestern coast of Yucatan. The range is not continuous and is marked by an apparent absence of brown shrimp along Florida's west coast between the Sanibel and the Apalachicola shrimping grounds. In the U.S. waters of the Gulf of Mexico, catches are high along the Texas, Louisiana, and Mississippi coasts. The larvae occur offshore and begin to migrate to estuaries as post-larvae. Post-larvae migrate through passes on flood tides at night mainly from February - April with a minor peak in the fall. Post-larvae and juveniles are common to highly abundant in Gulf of Mexico estuaries. In estuarine areas, brown shrimp post-larvae and juveniles are associated with shallow vegetated habitats (including SAV, soft bottom, sand/shell, emergent marsh, and oyster reef habitat), and occasionally, in silty sand and non-vegetated bottoms. Juveniles and sub-adults occur from secondary estuarine channels out to the continental shelf, but prefer shallow estuaries areas, particularly the soft, muddy areas associated with plant-water interfaces. Sub-adults migrate from estuaries during outgoing high tides and adult brown shrimp typically inhabit Gulf waters from the Mean Low Water line to the continental shelf (GMFMC 2006). Post-larvae, early juvenile, and late-juvenile brown shrimp use estuarine habitat for survival. Emergent marsh and marsh edge are particularly important microhabitats for these species, and they would use the tidal cycle to enter low emergent marsh adjacent to the shoreline (GMFMC 2004). Early juvenile brown shrimp habitat is found within the project area.

White Shrimp

White shrimp are offshore and estuarine dwellers, and are pelagic or demersal depending on their life stage. The eggs are demersal and larval stages are planktonic, and both occur in nearshore marine waters. Post-larvae migrate through passes mainly from May-November with peaks in June and September. Post-larval white shrimp become benthic upon reaching the nursery areas of estuaries, seeking shallow water with muddy-sand bottoms that are high in organic detritus or abundant marsh. Post-larvae and juveniles inhabit mostly mud or peat bottoms with large quantities of decaying organic matter or vegetative cover. Densities are usually highest in marsh edge and seagrass, followed by marsh ponds and channels, inner marsh, and oyster reefs. Juveniles move from estuarine areas to coastal waters as they mature. Migration from estuaries occurs in late August and September and appears to be related to size and environmental conditions (e.g., sharp temperature drops in fall and winter). Adult white shrimp are demersal and generally inhabit nearshore Gulf waters in depths less than 100 feet on soft mud or silty bottoms. (GMFMC, 2006) Adult white shrimp and spawning habitat occurs within the project area. Early juvenile white shrimp habitat is found within the project area.

3.2.3 Reef Fish

The reef fish FMP in the area of proposed action include gray and lane snappers. Reef fish utilize a variety of habitats including SAV, soft bottom, hard bottom, sand/shell, and emergent marsh during their juvenile and adult life cycle stages. Juveniles of many reef fish species are located in shallow, inshore areas especially associated with SAV beds and inshore reefs. There is a general tendency for older and larger fish to occur in deeper water extending to the edge of the continental shelf. Some juvenile snapper and grouper such as mutton, gray, lane, and yellowtail snappers and red grouper have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC 1981).

In general, reef fish are widely distributed in the Gulf of Mexico, occupying both pelagic and benthic habitats during their life cycle. A planktonic larval stage lives in the water column and feeds on zooplankton and phytoplankton. Juvenile and adult reef fish are typically demersal and usually associated with bottom topographies on the continental shelf (<100 m) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. Some juvenile snapper and grouper such as mutton, gray, red, dog, lane, and yellowtail snappers, jewfish, and red, gag, and yellowfin groupers have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC 1981). The following briefly summarizes the reef fish species in the area of the proposed action.

Gray Snapper

The gray snapper occurs on the shelf waters of the Gulf and is particularly abundant off south and southwest Florida. Gray snapper occur in almost all of the Gulf's estuaries but are most common in Florida. Adults are demersal and mid-water dwellers, occurring in marine, estuarine, and riverine habitats. They occur up to 32 km offshore and inshore as far inland as coastal plain freshwater creeks and rivers. They are found among mangroves, sandy grassbeds, and coral reefs and over sandy, muddy and rocky bottoms. Spawning occurs offshore around reefs and shoals from June to August. Post-larvae move into estuarine habitat and are found especially over dense grass beds. Juveniles also are marine, estuarine, and riverine dwellers, often found in estuaries, channels, bayous, ponds, grassbeds, marshes, mangrove swamps, and freshwater creeks. They appear to prefer grass flats, marl bottoms, seagrass meadows, and mangrove roots.

Lane Snapper

The lane snapper occurs throughout the shelf area of the Gulf in depths ranging from 0 to 130 m. The species is demersal, occurring over all bottom types, but is most common in coral reef areas and sandy bottoms. Spawning occurs in offshore waters from March through September (peak July-August). Nursery areas include the mangrove and grassy estuarine areas in the southern Texas and Florida and shallow areas with sandy and muddy bottoms off all Gulf states. Early and late juveniles appear to favor grass flats, reefs, and soft bottom areas to offshore depths of 20 m (NOAA, 1985). Adults occur offshore at depths of 4 to 132 m on sand bottom, natural channels, banks, and man-made reefs and structures.

All of the proposed action project areas includes EFH gray and lane snapper that utilize the estuarine zone in certain life stages. They are transitory species and use inshore environments part of the year. Only gray snapper use the estuarine zone as adults for feeding. Early juvenile and late juvenile lane snappers may use this habitat for growth and feeding.

3.2.4 Highly Migratory Species

Estuarine waters like those found in the proposed action area provide EFH resources for various life stages of HMS. Sharks enter the shallow estuarine bay waters to forage and feed. The shark species discussed in this assessment generally feed on a variety of small fish (such as menhaden, seatrout, croaker, and perch), shrimp, small sharks, crabs, and seagrass (most likely a result of foraging behavior).

HMS may be found in large expanses of the world's oceans. Although many of the species frequent other oceans of the world, the Magnuson Stevens Act only authorizes the description and identification of EFH in federal, state, or territorial waters, including areas of the U.S. Caribbean, the Gulf of Mexico and the Atlantic coast of the United States, to the seaward limit of the U.S. Exclusive Economic Zone (waters 3 to 200 miles offshore). These areas are connected by currents and water patterns that influence the occurrence of HMS at particular times of the year. Estuarine waters like those found in the proposed action area provide EFH resources for various life stages of HMS. Sharks enter the shallow estuarine bay waters to forage and feed.

Scalloped Hammerhead Shark:

This species is very common, large, schooling shark that occurs in warm coastal waters out to the continental shelf and seasonally migrates into the Gulf of Mexico. The scalloped hammerhead shark is considered vulnerable to over-fishing due to its schooling habits which make them extremely susceptible to gillnet fisheries. Neonates of this species (total length = 46 to 53 cm) are observed along the beaches of the lower Texas coast in late spring and early summer. Young-of-the-year scalloped hammerheads are present in bays and nearshore nurseries during the summer months in the Florida areas of Yankeetown, Tampa Bay, and Charlotte Harbor as well as along the beaches of the lower Texas coast (NMFS 2006). Habitat for neonates and juveniles occurs in the project area for Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point Islands.

Blacktip Shark:

Blacktip sharks inhabit the shallow coastal waters and estuaries of the United States. In addition, they are found in offshore surface waters. In the southeastern United States it ranges from Virginia to Florida and the Gulf of Mexico. The nursery areas are located in the inshore waters from South Carolina to Texas. The young are born at 55 to 60 cm total length in late May and early June in shallow coastal nurseries from Georgia to the Carolinas, and in bay systems in the Gulf of Mexico, and the Texas coast. Blacktip shark pupping begins as early as mid-April and can continue until as late as the first week of September, with the peak occurring in June (NMFS 2006). Adults and juveniles can be found year round in groups feeding in shallow waters of the Gulf of Mexico. This species is fast growing and reaches maturity at approximately 4-5 years of age. They generally feed on fish and invertebrates. The blacktip shark is part of the larger coastal shark management group, but does not have specific management measures in place. Habitat for neonates, juveniles, and adults occurs in the project area for Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point Islands.

Bull Shark:

The bull shark is primarily found in the shallow coastal waters of the Gulf of Mexico and is commonly found in the estuaries and lower reaches of the tributaries adjacent to the Gulf. Neonate bull sharks have been found in Yankeetown, Tampa Bay, Charlotte Harbor, Ten Thousand Islands, and Texas between the months of May and August. Young-of-the-year bull sharks are found in these same areas throughout the warm months and remain in these primary nurseries until as late as November or until water temperatures fall to about 21°C (Hueter and Tyminski 2007). Older juveniles return to these nursery areas in the spring as early as April and remain in the bays throughout the summer before undertaking their fall migration in October and November. Texas bull sharks show a similar temporal pattern; although older juvenile bull sharks utilize estuarine nursery areas, they do not appear to venture as far into freshwater as the neonates and young-of-the-year (NMFS 2006). This species reaches maturity at approximately 6 years of age. Bull sharks are part of the large coastal shark management group that is considered overfished, and regulations are in place for commercial and recreational harvest of this species. Habitat for neonates, juveniles, and adults occurs in the project area for Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point Islands.

Lemon Shark:

The lemon shark is commonly found in subtropical shallow water to depths of 300 feet. They inhabit coral reefs, mangroves, enclosed bays, sounds and river mouths. During migration, lemon sharks can be found in oceanic waters but tends to stay along the continental and insular shelves. Lemon sharks are reported to use coastal mangroves as nursery habitats, although this is not well documented in the literature. Females and males reach sexual maturity around 6-7 years of age. The lemon shark preys on bony fish and crustaceans. Reproduction occurs in shallow water during the spring months and is followed by a 10-12 month gestation period. The young remain in these nursery grounds for several years. Habitat for neonates occurs in the project area for Dickinson Bay II, Rollover Bay, and Smith Point Islands. Habitat for juvenile lemon sharks is present in the Dressing Point Island project area.

Spinner Shark:

The distribution of spinner sharks includes the inshore to offshore waters over continental shelve in the Gulf of Mexico. They range in water depths of 0-328 feet. The spinner shark forms schools and is considered a highly migratory species in the Gulf of Mexico, moving inshore during spring and summer months to reproduce and feed. Spinner sharks reach maturity at approximately 5 to 7 feet in length. Nursery areas for the spinner shark have been found along the beaches and in the bays of Texas during the summer months, and juvenile spinner sharks also have been found in the coastal waters of Mississippi and Louisiana and along the beaches of Tampa Bay in Florida. Larger juveniles have been captured off Sarasota, Tampa Bay (NMFS 2006) and Texas. The spinner shark feeds primarily on pelagic fishes, stingrays, cuttlefish, squid, and octopi. They reproduce in the shallow waters of the Gulf. Habitat for neonates and juveniles occurs in the project area for Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point Islands.

Bonnethead Shark:

The bonnethead shark commonly inhabits the estuaries and shallow coastal waters of the Gulf of Mexico and typically feed in the surf zone and inlets. They usually occur at depths of 30 to 60 feet, but have been noted in waters up to 250 feet in depth. The bonnethead primarily forages on crustaceans, bivalves, and small fish. They quickly reach maturity and mate year round. Habitat for neonates, juveniles, and adults occurs in the project area for Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point Islands.

Atlantic Sharpnose Shark:

The Atlantic sharpnose commonly inhabits warm-temperate and tropical waters of the Gulf of Mexico. This species seasonally migrates inshore to offshore. They are found at depths up to 920 feet (280 m), but mostly remain in waters less than 32 feet (10 m) deep. Along with being common residents of the surf zone, the Atlantic sharpnose shark is also found in estuaries and harbors. Habitat for neonates, juveniles, and adults occurs in the project area for Dickinson Bay II, Rollover Bay, Smith Point, and Dressing Point Islands.

Finetooth Shark:

The finetooth shark resides in waters close to shore to depths of 32.8 feet. This species often forms large schools. Important nursery habitat is located in South Carolina, Louisiana, and off the coast of Texas (NMFS 2006). Adults and juveniles are common in shallow coastal waters off Texas during the warm summer months and migrate south when surface water temperatures drop. Finetooth sharks are small in size with the average lengths for a male individual is 5.2 feet while a female is about 5.4 feet. Males reach maturity at about 3.9 feet in length and females mature at about 4.6 feet. They feed on small bony fishes and marine invertebrates including cephalopods and crustaceans. Only habitat for neonates is present in the project area for Dressing Point Island.

4 ASSESSMENT OF IMPACTS AND MITIGATIVE MEASURES

The Implementing Trustees (Department of the Interior, Texas Commission on Environmental Quality, Texas General Land Office, and Texas Parks and Wildlife Department), in consultation with the contractors, would take all practicable precautions to minimize unavoidable negative impacts to EFH. The project would result in both permanent and temporary impacts to EFH. The project would result in permanent loss of submerged bay habitat. However, the overall loss of EFH caused by the creation of the four rookery islands would provide an overall net ecosystem benefit to estuarine systems through the creation of colonial waterbird nesting habitat. The potential impacts and minimization/mitigative measures are discussed in greater detail below.

4.1 IMPACTS TO EFH

The following is a description of the four rookery islands. The siting of the protective structures and shell hash, as well as the footprint of the islands are conceptual and subject to refinement. For the purposes of impact analysis, the Trustees have conservatively estimated the maximum footprint for permanent and temporary impacts resulting from the deployment of breakwaters, expansion of the island footprint, placement of shell hash. Additionally, an estimated project area which may be directly or indirectly impacted, including the breakwater, armored levee, or other structure, shell hash, earthen fill, construction and staging areas, is also provided. The calculated impact footprint does not include the fill source area or the excavation of temporary access channels because a determination has not yet been made if they will be needed for this project. To the extent practicable, seagrasses and oyster reefs would be avoided. Oyster surveys inventories would be completed as part of project engineering and design. Other reasons for refinement in project location include but are not limited to:

- Avoidance of natural or cultural resources (e.g. oysters, seagrasses or archaeological sites);
- Engineering considerations including but not limited to geotechnical, hydrological, navigation, construction materials, construction techniques or bathymetric design constraints;
- Input received during the public comment period.

Dickinson Bay Island II

The preliminary plan contains the following elements that would impact EFH:

- Construct 4 island acres by placing clean fill over submerged land;
- Construct 2,000 feet of armored levees to protect the restored island; and
- Build 0.8 acres of submerged levee.

The area that may be directly or indirectly impacted is about 15 acres and includes the breakwater, armored levee, or other structure, submerged levee, earthen fill, construction and staging areas. The fill source area and temporary access channels are not included in this footprint estimate because they have not yet been identified.

Rollover Bay Island

The preliminary plan contains the following elements that would impact EFH:

- Construct 10 island acres by placing clean fill over submerged land or existing land (if present) and
- Construct 4,500 feet of armored levees to protect the restored island.

The area that may be directly or indirectly impacted is about 25 acres and includes the armored levee, or other structure, earthen fill, construction and staging areas. The fill source area and temporary access channels are not included in this footprint estimate because they have not yet been identified.

Smith Point Island

The preliminary plan contains the following elements that would impact EFH:

- Construct 6 island acres by placing clean fill over submerged land;
- Construct 250 feet of new breakwater to protect the restored and existing island; and
- Raise the elevation on 2 acres within the footprint of the existing island with shell material to build an emergent shell beach.

The area that may be directly or indirectly impacted is about 28 acres and includes the breakwater, armored levee, or other structure, shell hash, earthen fill, construction and staging areas. The fill source area and temporary access channels are not included in this footprint estimate because they have not yet been identified.

Dressing Point Island

The preliminary plan contains the following elements that would impact EFH:

- Construct 5 island acres by placing clean fill over submerged land;
- Construct 5,000 feet of breakwater to protect the restored and existing island; and
- Raise the elevation of an existing shell knoll to build 0.35 acres emergent shell hash.

The area that may be directly or indirectly impacted is about 56 acres and includes the breakwater, armored levee, or other structure, shell hash, earthen fill, construction and staging areas. The fill source area and temporary access channels are not included in this footprint estimate because they have not yet been identified.

4.2 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

Permanent loss of EFH would be localized to the fill area and erosion control structures (breakwater, armored levee, other levee) at each rookery island. Details regarding the impacts are described above and in Table 1. Following construction, there is expected to be utilization of the breakwaters, armored levees, and near-shore environment (shell hash) by aquatic fish species and a beneficial, long-term impact is anticipated. Most motile fauna such as crab, shrimp, and finfish would likely avoid the area of proposed action during the construction process. The project may result in minor, adverse short-term impacts to benthic organisms and temporarily affect habitat utilization by individuals considered under

EFH fishery management plans. However, any impacts to hard bottom substrates would be mitigated by creating additional hard bottom substrate as necessary. A field survey will be conducted prior to construction activities to identify any seagrasses or hard bottom substrates.

Environmental consequences of the proposed action include a discussion of the direct, indirect, and cumulative impacts in the section below.

4.2.1 Direct Impacts

This project would cause minor localized impacts to estuarine areas that are considered EFH for various life stages of the species managed under FMPs. Minor long-term impacts to EFH components are expected to the soft bottom substrates directly impacted by the footprint of the restoration area, potentially the fill source area (an upland site may be chosen), and potentially temporary access channels.

Direct impacts caused by the placement of fill, dredging, improvement of the shell hash habitat, construction of the breakwaters/levees, and disturbance to the bottom and turbidity are discussed in detail below.

Placement of Fill

The project would result in the permanent loss of 25 acres of submerged bay habitat designated as EFH for federally managed fish species through the filling of existing estuarine water column and the underlying estuarine mud/sand/shell substrates to convert these aquatic areas to uplands suitable for bird nesting. Areas proposed to be filled would be located to avoid filling oyster reef habitat and seagrasses. There is the potential for seagrasses to be present in the Dressing Point Island project area. Updated surveys that identify that extent of oyster and seagrasses will be conducted, where appropriate, prior to project implementation. To the extent practical, impacts to seagrasses will be avoided. If hard bottom substrates (e.g., winnowed oyster shell) are impacted during construction, there will be additional shell-like material added to the project area to mitigate impacts to hard bottom substrate (see Figures).

Disturbance of the bottom sediment by placement of the fill material may impact red drum (larvae, post-larvae, juvenile, and adult), adult gray snappers, juvenile lane snappers, early juvenile brown shrimp, and early juvenile white shrimp. The adverse impacts from placement of the fill materials will be localized and temporary, affecting individuals and not entire populations. Since potential impacts will be minimal, localized and temporary, there are no expected impacts to populations since spawning, feeding, and resting occurs over broad areas.

Dredging

Dredging, if required, for site access or to obtain fill for island restoration would also result in impacts to EFH. Areas proposed to be dredged would be located to avoid excavation of oyster reef habitat. There is the potential for seagrasses to be present in the Dressing Point Island project area. Updated surveys that identify that extent of oyster and seagrasses will be conducted, where appropriate, prior to project implementation. To the extent practical, proposed dredge areas would be located to avoid shell reef habitat and seagrasses. Therefore, the resulting impacts to dredging open water soft bottom habitat would be minor. Dredged areas would be excavated to a maximum of 5 feet below grade, but would fill in quickly with bay sediments. Dredged areas would also be excavated in slightly deeper open water habitat which would continue to function as EFH. Existing soft bottom benthic habitat at these dredging locations would be temporarily disturbed, but benthic invertebrate communities would quickly re-establish. If hard bottom substrates (e.g., winnowed oyster shell) are impacted during construction, there will be additional shell-like material added to the project area to mitigate impacts to hard bottom substrate (Figures 4). Additionally, Dressing Point Island and Smith Point Island have additions of shell-like material incorporated into the project design.

Shell Hash Habitat

The project would raise the elevation of 2 acres of existing intertidal reef at Smith Point Island and 0.35 acres of an existing shell knoll at Dressing Point Island. The loss of intertidal and supratidal reef would be an impact to EFH. However, the intertidal portion of the reefs would also be increased in size thus providing replacement subtidal and intertidal reef that will serve as foraging habitat for fish species.

Shell-like materials will be obtained from commercial suppliers. This source of material has no adverse impacts to the aquatic environment. If shell is used, efforts will be made to obtain it from commercial sources where no impacts to habitat were made during shell acquisition. There are several commercial sources of cultch material and shell, and no one source has been specified for use.

Breakwaters/Levees

The proposed breakwaters/levees will result in the permanent filling of EFH. However, the submerged side slopes of the breakwaters should provide hard substrate with interstitial spaces that provide enhanced foraging areas for fish and cover for juvenile fish as well as providing substrate for establishment of oyster habitat. Following placement and settlement of the materials on the bay floor, it is expected that the increase hard bottom structure will attract reef fish, migratory fish, mobile crustaceans and other invertebrates.

Bottom Disturbance and Turbidity

There will be elevated turbidity impacts to EFH during dredging and placement of fill for the construction of the islands. Deployment of the breakwaters, shell reef habitat, and temporary access channels would result in short-term, minor adverse impacts to water quality as a result of re-suspension of sediment by vessels (barges, tugs, skiffs, etc.) moving in and out of the area of proposed action. However, these impacts will be temporary and minor in scope.

Disturbance of the bottom sediment by placing hardened structure may temporarily affect prey availability in the area of proposed action for juvenile and adult fish. The adverse impacts from placing material would be short-term, localized and minor, affecting individuals and not entire populations. Since potential impacts would be localized and short term, there are no expected impacts to populations since spawning, feeding, and resting occurs over broad areas. In areas with existing oyster reefs, BMPs will be utilized to minimize sedimentation to avoid impacts to the oysters.

Best management practices along with other avoidance and mitigation measures required by state and federal regulatory agencies would be employed to minimize potential water quality and sedimentation impacts. U.S. Army Corps of Engineers Section 10/404 permit would be required; all project activities would be conducted in compliance with permit conditions. Measures to control turbidity caused by construction activities, decant water, and sediment movement would be in place to ensure sensitive habitats are protected, water quality standards are met, and sensitive resources are not significantly affected. These measures may include appropriate water control structures to decant water, as well as the installation of silt fences, hay bales, filter-fabric, and/or temporary levees to control sediments and avoid negative impacts associated with the fill placement. Impacts from turbidity would be minor, short-term and limited in spatial extent.

4.2.2 Indirect

Indirect adverse impacts are not expected in the short or long-term. Long-term indirect benefits are expected to EFH resources in close proximity to the project due to anticipated increases in use of this area by red drum (larvae, post-larvae, juvenile, and adult), adult gray snappers, juvenile lane snappers, early juvenile brown shrimp, and early juvenile white shrimp. Additionally, this project will increase and improve nesting habitat for colonial waterbirds.

4.2.3 Cumulative

Essential fish habitat has been altered by other restoration projects. This project would convert some open water estuarine habitat into coastal upland habitat. The amount of open water habitat in these bays is expected to increase in the future and the impacts of these projects are negligible. Hard substrates may be affected by this project, however, this habitat type is expected to increase over time by ongoing restoration projects targeting oyster reef habitat and those using hard substrate for armoring shorelines. This project would add a hard substrate component in the form of breakwater, armoring, and additional shell-like material. Increasing structural habitat and reduced shoreline erosion would improve EFH in the area.

Overall, the cumulative impacts of the proposed Texas Rookery Islands project when considered with respect to past, present, and reasonably foreseeable future actions would result in beneficial impacts over the long-term and negligible short- or long-term adverse impacts. This project would contribute not only to the restoration and protection of colonial nesting waterbirds but help ameliorate potential future adverse impacts associated with past, present and future changes expected for the upper Texas coast.

5 PROPOSED MITIGATIVE MEASURES AND GUIDELINES FOR EFH PROTECTION

Best management practices (BMPs) are measures to minimize and avoid potential adverse impacts to EFH during the implementation of the Texas Rookery Islands Project. This conservation measure requires the use of BMPs during construction to reduce impacts from project implementation. BMPs may include but are not limited to:

a. All provisions and mitigation measures of any federal permits and/or consultations will be followed.
b. Employment of standard BMPs for construction to reduce erosion and exported sediments.
c. Evaluations of potential borrow sites for environmental conditions as well as cultural and sensitive resources concerns.
d. Selection of a borrow site with a minimal footprint and sediment accretion to minimize impacts and expedite rate of recovery.
e. Follow the NOAA's Sea Turtle and Smalltooth Sawfish Construction Conditions (NOAA 2006).
f. Follow the NOAA's Measures for Reducing Entrapment Risk to Protected Species (NOAA 2012).
g. Fill in the temporary access channels after installation of the structures is completed.
h. Follow all provisions and stipulations identified during the consultations with USFWS and NMFS.
i. Employ, as appropriate, appropriate water control structures to decant water, as well as the installation of silt fences, hay bales, filter-fabric, and/or temporary levees to control sediments and avoid negative impacts associated with the fill placement.

Measures to control turbidity caused by construction activities, decant water, and sediment movement would be in place to ensure sensitive habitats are protected, water quality standards are met, and sensitive resources are not affected. These measures may include appropriate water control structures to decant water, as well as the installation of silt fences, hay bales, filter-fabric, and/or temporary levees to control sediments and avoid negative impacts associated with the fill placement. The nearby presence of oyster reefs, other hard structure reef resources, and seagrass beds near some islands would require the use of significant control measures during project implementation.

6 CONCLUSIONS

Overall, there will not be a substantial adverse impact to EFH. The potential adverse impacts related to the Texas Rookery Islands project will be minor, short-term and long-term. The potential long-term benefits to EFH, especially for red drum, shrimp, reef fish, and highly migratory species include increased foraging habitat, and increased cover for juveniles.

7 REFERENCES/LITERATURE CITED

Galveston Bay Foundation (GBF). 2014. Dickinson Bay Bird Nesting Islands Alternatives Analysis. October 2014.

Gulf of Mexico Fishery Management Council (GMFMC). 1998. Generic Amendment for Addressing Essential Fish Habitat Requirements in the following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Waters, Red Drum Fishery of the

Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic, Stone Crab Fishery of the Gulf of Mexico, Spiny Lobster in the Gulf of Mexico and South Atlantic, Coral and Coral Reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, 3018 U.S. Highway 301 North, Suite 100, Tampa, Florida. October 1998. (http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/FINALEFH-%20Amendment%201-%20no%20appendices.pdf)

GMFMC. 1981. Final Environmental Impact Statement and Fisheries Management Plan for the Reef Fish Resources of the Gulf of Mexico. GMFMC, Tampa, FL. August 1981.

National Council for Agricultural Education. 1995. Red Drum: Aquaculture Curriculum Guide Species Specific Module. National Marine Fisheries Service (NMFS). 2009. Final Amendment 1 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery

Management Plan, Essential Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. pp. 395.

NMFS. 2006. Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. pp. 1600. (http://www.nmfs.noaa.gov/sfa/hms/documents/fmp/am1/feis/feis_amendment_1_chapter5.pdf)

NOAA. 2012. Measures for Reducting Entrapment Risk to Protected Species. May 22, 2012.NOAA. 2006. Sea Turtle and Smalltooth Sawfish Construction Conditions, NOAA Endangered Species Series (Mar. 23, 2006) http://sero.nmfs.noaa.gov/pr/endangered%20Conditions%203-23-06.pdf

NOAA. 2007. Revision 2 of the Gulf of Mexico hopper dredging regional biological opinion (GRBO). Date issued: January 2007.

Overstreet, Robin M. and R.W. Heard. 1978. Food of the Red Drum *Sciaenops ocellata*, From Mississippi Sound. Gulf Research Reports. 6 (2): 131-135. http://www.usm.edu/gcrl/public/fish/docs/food.of.the.red.drum.overstreet.heard.gulf.research.reports.vol6.no2.pdf