Gulf of Mexico Fishery Management Council
Gulf of Mexico Mesophotic and Deepwater Coral Assessment

Progress Report

WORKING DRAFT FOR REVIEW -VERSION 2

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1.0 Introduction

CSA Ocean Sciences Inc. (CSA) was contracted by the Gulf of Mexico Fishery Management Council (Council) to compile and synthesize information on deep-water coral and coral related habitats throughout the Gulf of Mexico (GoM) Exclusive Economic Zone (EEZ). The project focused on mesophotic (30 to 150 m) and deep-water corals (deeper than 50 m) (hereafter termed deep reef corals) in federal waters of the GoM from 9 to 200 nautical miles offshore. The project includes the production of a report and development of a geodatabase and web-based dashboard that will comprise coral presence, coral density, coral species diversity, and benthic habitat composition of areas that support corals more broadly, such as deep-water banks, hard-bottom habitats, and isolated patch reefs. The design and content of the project was the result of continual coordination and consultation with Council staff throughout the completion of the scope of work.

1.1 PROJECT BACKGROUND

In 2014, the Council's Coral Working Group identified potential areas, including existing Habitat Areas of Particular Concern (HAPCs), to be considered for additional conservation and management measures due to the presence of deep-water coral communities recorded in these areas. As defined by the Magnuson-Stevens Fishery Conservation and Management Act of 2007 (NOAA Fisheries, 2022), a HAPC is a discreet subset of Essential Fish Habitat (EFH) that meets one or more of the following criteria:

1. importance of ecological function provided by the habitat;
2. area or habitat is sensitive to human-induced degradation;
3. the habitat is stressed; and
4. is considered rare.

EFH comprises those waters and substrate necessary to fishes for spawning, breeding, feeding, or growth to maturity, and includes all types of aquatic habitat where fishes spawn, breed, feed, or grow to maturity, such as wetlands, coral habitats, seagrass habitats, and rivers (NOAA Fisheries, 2021).

The purpose of HAPCs is to highlight priority areas within EFH to focus conservation, management, and research efforts (Marinecadastre, 2021).

In 2018, after review by the Council's advisory bodies, the list of HAPCs was shortened and the National Marine Fisheries Service implemented 'Coral Amendment 9', which established 13 new HAPCs within the northern GoM with fishing regulations that prohibit deployment of bottom-tending gear and anchoring by fishing vessels, and eight GoM HAPCs without development of specific, associated fishing regulations (Gulf of Mexico Fishery Management Council, 2018) (**Table 1, Figure 1**).

Table 1. Habitat Areas of Particular Concern (HAPCs) established by the Gulf Council Coral Working Group in 2018 (Coral Amendment 9). (GMFMC, 2018). HAPCs listed in alphabetical order.

Newly Established HAPCs	HAPCs with Fishing Regulations	HAPCs without Fishing Regulations
Alabama Alps	•	
AT 047	•	
AT 357	•	
Garden Banks 299		•
Garden Banks 535		•
Green Canyon 140/272		•
Green Canyon 234		•
Green Canyon 354		•
Green Canyon 852	•	
Harte Bank	•	
L&W Pinnacles	•	
Mississippi Canyon 118	•	
Mississippi Canyon 751		•
Mississippi Canyon 885		•
Rough Tongue Reef	•	
Scamp Reef	•	
South Reed Site		•
Southern Bank	•	
Viosca Knoll 826	•	
Viosca Knoll 862/906	•	
West Florida Wall	•	

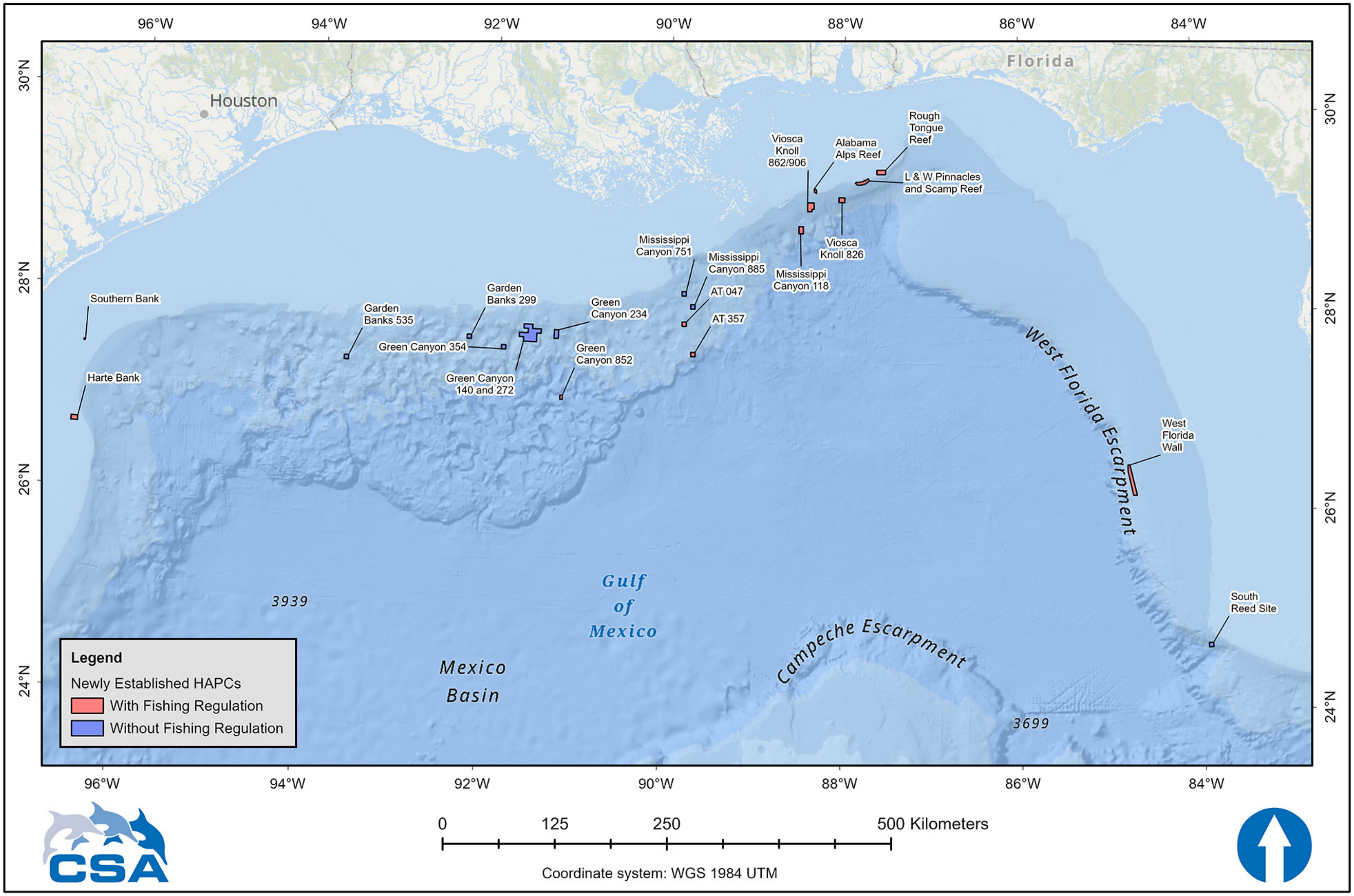

Figure 1. Gulf of Mexico Habitat Areas of Particular Concern (HAPCs) established by the Gulf of Mexico Fishery Management Council (Council) in 2018 (Coral Amendment 9).

After Coral Amendment 9, the Council reconvened the Coral Advisory Panel and Coral Statistical and Scientific Committee to reevaluate priority areas to be considered as HAPCs through 'Coral Amendment 10'. This reexamination included, but was not limited to factors such as depth, habitat type, abundance, density, and diversity information for areas included in Coral Amendment 9 that the Council selected not to move forward with, as well as any new information on other regional (northern GoM) areas.

1.2 PROJECT PURPOSE AND OBJECTIVES

This project was designed to address the Council's request to compile and synthesize information on GoM coral and coral-related habitats at sites that were proposed but not included in Coral Amendment 9, as well as the identification and review of other habitats in the region that might warrant similar conservation and management measures.
Objectives of the project to meet the goals of the Council include the following:

- Site Selection – Select a set of sites, or areas initially identified by the Coral Working Group for the focus of the project, considering both historical survey reports or recent data and reports for new, additional information on site conditions.

- Literature Review – Conduct a comprehensive literature review of the selected deep reef coral areas and identify other ecologically important coral habitat that may benefit from management measures. Conduct a separate data search of available information on the vulnerability of corals found within the selected areas of the GoM to disease (e.g., scleractinian coral tissue loss, disease spread) and potential impacts to these corals from environmental changes (e.g., changes in ocean circulation patterns, temperature, pH). Identify informational data gaps during the data compilation task.

- Data Compilation – Compile the most up-to-date information on selected sites as it relates to the presence of deep reef corals, coral diversity, as well as other benthic habitat attributes more broadly for those areas where corals have been documented to occur. Identify informational data gaps.

- Geodatabase – Construct a geodatabase for spatial data using format templates provided by Council staff for point datasets and include metadata in Federal Geospatial Data Committee (FGDC) standard.

- Ecological Assessment – Design and conduct a general ecological assessment of those areas where corals are identified as a conspicuous element of the bottom, providing, to the extent practical, a consistent level of detail for comparison across and among areas. Include an assessment of potential risks to corals in those areas and the services that they provide. If available, include economically important fishery species and their association with the benthic habitat. Provide an assessment of vulnerability of corals to disease and potential impacts of environmental changes. Rank the areas based on physical and ecological data to provide objective criteria which the Council could use to prioritize the development of management measures.

- Web-based Dashboard – Design and provide a web-based dashboard with an interactive map displaying the shape/area and coordinates of the areas to be considered and associated information.

2.0 Methods

2.1 ECOLOGICAL ASSESSMENT

The Ecological Assessment included the systematic completion of several project objectives, including the selection of suitable and approved sites for study, a search and review of pertinent data sources on these sites, a compilation of these sources by site, and the design of the ecological assessment using available information. The design and methods for the assessment are provided below.

2.1.1 Site Selection

The Council supplied the CSA Team with supportive information (reports) providing lists of areas (hereafter termed project sites), including existing HAPCs, to be reviewed and analyzed for this project. These reports included the following: Joint Coral Scientific and Statistical Committee and Coral Advisory Panel Summary (Joint Coral Scientific and Statistical Committee and Coral Advisory Panel, 2015); Coral Working Group Summary, Gulf Council Office, Tampa, FL (Coral Working Group, 2014); and Coral Habitat Areas Considered for Habitat Area of Particular Concern Designation in the Gulf of Mexico (Coral Amendment 9) (Gulf of Mexico Fishery Management Council, 2018). Additional areas of coral habitats in the region were reviewed as potential candidate sites, based on CSA Team experience in these areas. The final selection of project sites is presented below in **Section 3.1.1**.

2.1.2 Data Search and Review

Identification of relevant source material began with an extensive search of scientific and technical databases on Proquest Dialog™[1]. Proquest Dialog™ is a unique aggregation of the world's leading bibliographic and full text sources and offers the largest collection of authoritative[2] content that can be searched at one time. The Proquest Dialog™ databank search was led by CSA's Librarian/Information Specialist, who was responsible for all literature searches and acquisition of relevant documents. The following databases were searched:

- Aqualine (1960-current);
- Aquatic Sciences & Fisheries Abstracts (1971-current);
- BIOSIS Previews® (1926-current);
- Ecology Abstracts (1982-current);
- Environmental Impact Statements: Digests (1985-current);
- GEOBASE™ (1980-current);
- Georef (1693-current);
- Meteorological & Geoastrophysical Abstracts (1950-current);
- NTIS: National Technical Information Service (1964-currrent);
- Oceanic Abstracts (1981-current);
- Proquest Dissertations and Theses Professional; and
- Scisearch® (1974-current).

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[1] http://dialog.proquest.com/professional

[2] "authoritative" refers to peer-reviewed documents but also documents published under the auspices of an agency or conference especially where the authors can be identified.

Initially, a broad topic search was conducted using the following search statement combinations[3]:

- (coral or corals or octocoral* or cnidaria*);
- (deepsea or mesophotic or "deep sea" or coldwater or "cold water" or "deep ocean"); and
- ("gulf of mexico" or atlantic).

This preliminary search generated 1,474 citations.

A subset of the above search was selected to address disease, temperature, and stress using the following search statement combinations:

- (coral or corals or octocoral* or cnidaria*);
- (temperature or disease? or stress*);
- (deepsea or mesophotic or "deep sea" or coldwater or "cold water" or "deep ocean"); and
- ("gulf of mexico" or atlantic).

This search generated 517 citations.

These searches resulted in an unmanageable number of citations relative to the scope of the project. Attempts to narrow the results by specifying that search terms must be found in the title or key word fields and limiting results to the last 10 years did not solve the problem (The numbers of citations listed above [1,474 and 517] were reduced to 524 and 239, respectively, when narrowed to the last 10 years). Although valuable references were located and acquired in these searches, CSA determined that a search for each specific reef or bank name as well as the larger sub-regions was required to produce a body of information that was informative at the site level but capable of being reviewed within existing resources.

Relevant books, proceedings, technical reports, and gray literature were also located using OCLC WorldCat. WorldCat is a cooperative database of a billion bibliographic records contributed by more than 72,000 libraries in 170 countries, making it the world's largest, most complete, and most consulted library union catalog. Items found in WorldCat may be purchased or borrowed via the OCLC Interlibrary Loan System. For Internet accessible documents, Google/Bing searches and searches from digital repositories such as Aquadocs https://aquadocs.org/, Biodiversity Heritage Library https://www.biodiversitylibrary.org/ and ESPIS https://marinecadastre.gov/espis/#/ were made.

All search results were reviewed by the CSA Team and the documents of interest were identified and returned to the librarian for acquisition. PDFs of all requests were acquired online, via interlibrary loan request, personal request to authors or other marine librarians, or downloaded from the existing CSA library collection.

From the search and review tasks, an Endnote™ X9 library was created for all documents used in the project. The library includes full citations with a PDF of the document attached. The citations can be exported as simple document files or may be converted for use in other bibliographic management software such as Mendeley, Zotero and Refworks.

[3] Search statements are not case sensitive. In these search statements, a question mark (?) indicates one letter truncation, an asterisk (*) indicates unlimited truncation, and parentheses () enclosing topics indicate a phrase search.

2.1.3 Ecological Assessment Design Overview

Pertinent, site-specific data were compiled within an ecological assessment data matrix to characterize and assess current environmental status and vulnerability of deep coral and hard-bottom sites in the GoM (and potentially other regions). Because analysis of newly acquired field data from recent studies were beyond the scope of this project, the assessment used data that were currently available for the selected GoM deep-reef sites; however, the assessment was also designed to be modified and improved as needed and as new, authoritative data become available. During this process, additional data needs (data gaps) were identified, leading to recommendations for new studies. The assessment matrix also allowed for an objective approach to site comparisons across the GoM.

The matrix was organized as follows. Each selected project site was entered on a separate row of the table and constituted the left column. The project sites were organized regionally to facilitate comparisons. Primary regions included the Southeastern, Northeastern, Southwestern, and Northwestern GoM. Regions were further subdivided, as follows:

Region	*Area*
Southeastern GoM	Northern West Florida Slope
	Southern West Florida Slope
Northeastern GoM	Pinnacles Reefs
	DeSoto Canyon
	Destin Dome
Northwestern GoM	Shelf-edge Banks
Southwestern GoM	South Texas Banks – North
	South Texas Banks – South

A list of physical and environmental factors were developed and entered as separate columns on the horizontal axis (top row) of the matrix. All included factors have known, accepted, and defensible ecological relevance. The list of environmental factors include:

- **Area**: Units = hectares. For this project, site boundaries were provided by the Gulf Council (and/or its committees) from previous designations. Using the provided site boundaries, CSA calculated site areas using ArcGIS.

- **Relief**: Units = meters. For sites with multibeam bathymetric data the relief used for the matrix was the maximum profile of the largest reef feature (e.g., wall, pinnacle, mound, etc.) within the site boundary determined from GIS analysis. Without multibeam or other geospatial data, it was not possible to estimate relief unless that was available from relevant literature.

- **Depth**: Units = meters. For sites with multibeam bathymetric data, the depth range was reported as the deepest and shallowest depths within the site boundary. For sites without multibeam or other geospatial data, depth range was estimated from NOAA navigation charts or from available literature.

- **Base Substratum**: This factor was restricted to represent the main material from which the reef feature was built (e.g., coral, rock (type, if known), consolidated muds, etc.). In some cases, coverage of area by various sediment and reef material was provided as notes in the matrix, if known.

- **Temperature Regime**: Units = degrees centigrade or generic designation if no explicit units were provided. The goal here was to determine not only the benthic temperature values but the degree of stability. If available, a range of temperatures was reported to infer variability. If no data existed, the temperature environment was approximated using generic descriptors (e.g., stenothermal, eurythermal, temperate, etc.).

- **Salinity Regime:** Units = standard salinity units or generic descriptors if no explicit data were available. As above, the goal was to describe benthic salinity values and variability. If available, a range of salinity values was reported. If there were no explicit data, the salinity environment was approximated using generic descriptors (marine, stenohaline, coastal, etc.) based on location of the site.

- **Proximity to Shore**: Units = kilometers. A geodesic (shortest path between two points on a curved surface) measurement using ArcGIS (Esri ArcGIS Pro version 2.3) from the center of each site to the nearest mainland. Here, and in all ArcGIS measurements, the center of the site or site polygon and latitude and longitude of each selected feature was determined using the Feature to Point tool in ArcPRO: https://pro.arcgis.com/en/pro-app/2.8/tool-reference/data-management/feature-to-point.htm. For an input polygon feature: the output point will be located at the centroid of the polygon. The NOAA Shoreline Website (NOAA / Medium Resolution Shoreline https://shoreline.noaa.gov/data/datasheets/medres.html) was used to determine the nearest shoreline.

- **Proximity to Nearest Major River**: Units = kilometers. A geodesic measurement using ArcGIS from the approximate center of each site to the mouth (visually approximated) of the nearest major river. The CSA in house database was used to determine the latitudes and longitudes of the site centers as well as the selected feature endpoint at the river mouth.

- **Proximity to Active Oil/Gas Activity**: Units = kilometers. A geodesic measurement using ArcGIS from the approximate center of each site to the nearest active offshore oil and gas platforms or facilities. The BOEM Geographical Mapping Data in Digital Format website (https://www.data.boem.gov/Main/Mapping.aspx) was used to determine the nearest offshore platform or rig and to determine the latitudes and longitudes of the site centers as well as the selected feature endpoint.

- **Proximity to Wind Fields**: Units = kilometers. A geodesic measurement using ArcGIS from the approximate center of each site to the nearest offshore wind facility. Current offshore wind sites exist solely off the Northeast coast of the US, although Federal administration goals predict renewable energy development within the GoM (BOEM, 2021). Therefore, wind fields were included as a placeholder in the data matrix but were not included in this analysis.

- **Proximity to Offshore Mining**: Units = kilometers. A geodesic measurement from the approximate center of each site to the nearest offshore mining facility was made using ArcGIS. There were no mining facilities identified in the GoM project area. Therefore, offshore mining was included as a placeholder in the data matrix but was not included in this analysis.

- **Proximity to Shipping Lane**: Units = kilometers. A geodesic distance was measured using ArcGIS from the approximate center of each site to the nearest major shipping lane. The CSA in house database was used to determine the latitudes and longitudes of the site centers as well as the selected feature endpoint.

- **Proximity to Other Protected Areas (already designated)**: Units = kilometers. A geodesic distance was measured from the center of each site to the nearest edge of the nearest site currently protected by state or federal law (e.g., Marine Sanctuaries, HAPCs, etc.). The USGS PAD-US Data Web Services (https://www.usgs.gov/core-science-systems/science-analytics-and-synthesis/gap/science/pad-us-data-web-services?qt-science_center_objects=0#qt-science_center_objects) and the Gulf Council Coral 9 HAPCs and Regulations portal (Coral 9 HAPC and Regulations Viewer [gulfcouncil.org])were used to determine the nearest protected area as well as the selected feature endpoint.

- **Proximity to Consistent Military Operations**: Units = kilometers. A geodesic distance was measured from the approximate center of each site to the nearest active military operations using ArcGIS. The CSA in house database was used to determine the latitudes and longitudes of the site centers as well as the selected feature endpoint.

- **Proximity to Dumping Areas (military, hazardous wastes, municipal, etc.)**: Units = kilometers. A geodesic measurement was made from the approximate center of each site to the nearest known dumping ground using ArcGIS. For ordinance disposal areas, the CSA in house database was used to determine the latitudes and longitudes of the site centers as well as the selected feature endpoint. For other dumping areas, the EPA Ocean Dumping website (https://www.epa.gov/ocean-dumping/managing-ocean-dumping-epa-region-4) was used to determine the latitudes and longitudes of the site centers as well as the selected feature endpoint.

- **Proximity to Benthic Methane Seeps**: Units = kilometers. This is a geodesic measurement using ArcGIS from the approximate center of each site to the nearest known methane seep location. Methane seep-related anomalies were selected from the following BOEM Seismic Water Bottom Anomalies websites:
    - https://services1.arcgis.com/Hp6G80Pky0om7QvQ/arcgis/rest/services/BOEM_Seismic_Water_Bottom_Anomalies/FeatureServer; and
    - https://www.boem.gov/oil-gas-energy/mapping-and-data/map-gallery/seismic-water-bottom-anomalies-map-gallery.

The following methane seep-related anomalies were selected from these data sources to plot their proximity to selected project sites:

- Seep-Related Confirmed Carbonate Anomalies;
- Seep-Related Confirmed Coral Anomalies;
- Seep-Related Confirmed Hydrate Anomalies;
- Seep-Related Confirmed Mud Volcano Anomalies;

- Seep-Related Confirmed Mud Volcano Gas Anomalies;
- Seep-Related Confirmed Organism Anomalies;
- Seep-Related Positive Confirmed Gas Anomalies; and
- Seep-Related Positive Confirmed Oil Anomalies.

- **Scleractinian Coral Species Richness**: Numbers of documented hermatypic (reef-building) species, genera, or families derived from available literature or in some cases from unpublished, but reputable, sources. These are generally colonial scleractinian corals of the genera *Lophelia*, *Enallopsammia*, *Madrepora, Oculina, Madracis,* and *Agaricia*.

- **Octocoral Species Richness**: Numbers of all documented species, genera, or families derived from available literature or in some cases from unpublished, but authoritative sources.

- **Hydrozoan (Orders Milleporina and Stylasterina) Species Richness**: Numbers of all documented species, genera, or families derived from available literature or in some cases from unpublished, but authoritative sources.

- **Antipatharian Species Richness**: Numbers of all documented species, genera, or families derived from available literature or in some cases from unpublished, but authoritative sources.

- **Fish Species Richness**: Numbers of all documented species, genera, or families derived from available literature or in some cases from unpublished, but authoritative sources.

- **Benthic Fishing Activity/Intensity – Bottom Long Line (BLL)**: Estimates of BLL fishing activity on reef fishes was identified. The spatial distribution and relative densities of reef BLL vessels across the GoM were derived from the summary of NOAA's Office of Law Enforcement and Southeast Fisheries Science Center (SEFSC) Vessel Monitoring System (VMS) data from 2010 to 2015 that was published by Clark et al. (2018 and are summarized here. BLL gear is prohibited shallower than 50 fathoms (91 m) west of Cape San Blas, FL. East of San Blas it is prohibited out to 20 fathoms (37 m) most of the year (September to May), and that closure extends out to 35 fathoms (64 m) from June through August (GMFMC, 2019). Given the restricted inshore effort and deep coral habitat focus of the analysis, the data were further restricted to fishing activity in waters deeper than 45 m. These filters resulted in a preliminary dataset of 373,605 VMS points from 83 vessels. VMS data are described and analyzed as number of estimated fishing positions. The SEFSC VMS data recorded during 2010 to 2015 included GPS position and various directional and speed measurements, typically recorded once per hour. Vessel fishing activity was not recorded but may be interpreted from vessel speed information. The VMS dataset was queried for vessels that possessed both the reef fish commercial permit and the BLL endorsement at the time of fishing. While the BLL endorsement is only required for fishing in the eastern Gulf, the presence of the annually renewed endorsement increased the likelihood that a vessel was engaged in bottom longlining, and no other fishing methods encompassed by the commercial reef fish permit (e.g., handline, bandit reel). Using Arc GIS, Clark et al. (2018) plotted the spatial distribution of BLL fishing effort (numbers of vessel positions) by aggregating vessel positions into a grid of 10 × 10 km cells across the Gulf to visualize summary data and obscure individual vessel movement. For this analysis, the suite of selected project sites was superimposed on the Clark et al. (2018) ArcGIS BLL data and the estimated value of the BLL fishing effort (positions) for the area within the project site polygon (minimum, maximum, and mean numbers of positions) were recorded.

- **Benthic Fishing Activity/Intensity – Bottom Trawl:** The spatial distribution of bottom trawl fishing effort used for this analysis was derived from NMFS SEFSC data from 2006 to 2013 programs that was summarized and published by Clark et al., (2018). Specific vessel data in the ELB program are confidential; therefore, relative trawl effort (i.e., the estimate of hours trawled within a given area) was plotted in ArcGIS and aggregated into a grid of 10 × 10 km cells across the Gulf by Clark et al. (2018) to visualize summary data and obscure individual vessel movement. These graphic data were superimposed on the project's site map, and values of trawl effort for each project site (minimum, maximum, and mean hours trawled) were recorded for each site.

- **Benthic Fishery Types and Gears at Site**: General bottom contact type and gear (e.g., shrimp, bottom trawl; recreational, hook and line, etc.). These data were primarily derived from Gulf Council and/or NOAA sources. In some cases, CSA experience in the region was used to modify categories.

- **Invasive Species**: Noted numbers and species where known derived from available literature or in some cases from unpublished, but reputable, sources. A note was made if it was known if this topic was ever addressed for a site.

- **Disease Incidence**: Types of disease and taxa affected derived from available literature or in some cases from unpublished, but reputable, sources. A note was made if it was known if this topic was ever addressed for a site.

- **Research History**: This category was given a qualitative descriptor of Extensive, Moderate, Low, or None based on the number and type of publications found for each site in CSA's literature search. The number and types of publications and studies were compiled for each project site.

- **Current Protections**: Existing federal or state rules that protect the habitat and or the associated biota were considered and noted for each site. Proposed or eminent rules were also considered if well documented.

- **Vulnerability to Climate Change**: This factor was difficult to assess, and information was often subjective. Specific literature on a site basis is generally lacking but the effects of climate change usually occur on a broad scale. This vulnerability cannot be accurately assessed until additional authoritative information becomes available.

Results from the data search and review were compiled by project site, and distances of each site to selected areas calculated and placed in the matrix (**Section 2.1.4**). Each environmental factor was assigned a relative value rating in terms of affecting environmental integrity and quality, resulting in an "index" that allowed a rapid evaluation of individual sites and comparisons among sites (**Section 2.1.5**).

2.1.4 Data Compilation

From the beginning of the project contract period, the CSA Team worked closely with the Council to refine the structure and content of the data review and compilation task. Information collected for each project site during the data search and review was examined, and information pertaining to the selected environmental factors was entered into corresponding cells for each project site. This resulted in a synoptic presentation of area-specific information that was used for site comparisons and rankings as part of the ecological assessment (**Section 2.1.5**). Sources of data used to populate each cell were embedded in the cell as notes. In cases where information (or reliable information) was not located, the cell was left blank. In cases where the cell was not applicable to the site, 'n/a' was entered in the cell.

The distance/proximity analysis was conducted in ArcPro version 2.8.3. Coral site centroids were created from a coral site polygon feature using a "Feature to Point" tool. The coral site centroids are representative of center points for each coral site. A "Near" analysis was then performed between the coral site centroids and each proximity feature. Proximity feature data sources are listed in the Coral Matrix Spreadsheet. Endpoints at the proximity features and lines connecting the coral site centroids to the endpoints were created using the "XY to line" tool. Geodetic distances were then calculated for each line using the "calculate geometry attributes" tool. Where information was not applicable, 'n/a' was entered in the cell.

2.1.5 Ranking of Environmental Factors and Final Scoring Methods

The main tool developed for the Ecological Assessment was the data matrix described in **Section 2.1.3**. The most difficult aspect of this project was assigning a rank value to each environmental factor. Factor rankings are relative and consider a set of attributes either on quantitative (e.g., distance from shore) or qualitative scales (e.g., "degraded" versus "healthy", based on subjective, visual assessments) and may incorporate generalized scaling terms (Altman et al. 2011). For example, publications (e.g., Moffitt et al. 2011; Vandeperre et al. 2011) usually suggest that for Marine Protected Area (MPA) design, bigger sites or linked sites are better than smaller or isolated sites. But, exactly how many hectares are required for an MPA to meet conservation objectives in a given region is rarely known, an exception being described by McLeod et al. (2009).

Each cell of the matrix contains a value for the factor for the given site. Based on the specificity of the available data that informed a value, a relative ranking was assigned to this value, and rank values are presented in a separate table. Factors are not equal in terms of their real or potential negative or positive impacts to deep reefs. For example, bottom trawling activity near or on a site would likely have much larger impact than would the site's proximity to shipping lanes. Thus, some factor rankings may be weighted in regard to the perceived likelihood of their influence (positive or negative) on reef ecology. Ranking criteria and values were defined after factor cells of a site's data matrix were filled in and their variabilities assessed. Site factors represented by numerical values were plotted as frequency distributions, which were used to categorize the range of factor values as well as the continuity of data and the shapes of frequency plots. Ranking numbers for all factors were totaled per site, and the higher the summed number the more healthy or less vulnerable the site. Data for some factors was so variable or potentially arbitrary that they could not be used for rankings. It should be noted that the greatest utility of this type of analysis or evaluation is realized by including all known sites, thus including all known ranges of variables. The current project does not include all GoM deep reef sites (see Site selection section), and so the subset of sites evaluated here imposes some limits to the ecological assessment.

Ranking methods for each environmental factor are described below. Note that actual point values that were assigned do not have intrinsic ecological meaning and were used to position the sites on a relative basis. What matters most is whether a site factor rated relatively high, low, or medium, not whether high was assigned a particular point value. Point assignments allowed all factors to be totaled in order to deliver a single ranking value for each site.

- **Area Ranking**: Because larger protected areas or ecosystems typically have more ecological or biodiversity buffering and thus, should be less vulnerable to disease or other impacts, the largest sites were ranked highest (least vulnerable). McLeod et al. (2009) suggested that MPAs should be a minimum of 10 to 20 km in diameter, which converts to a circular area of 78.5 to 314 sq km (7,850 to 31,400 ha). We assumed this criterion could be relevant to GoM deep reefs and thus assigned higher weighting (3 extra points) to sites that were >17,671 ha in area. This represented the midpoint of size suggested by McLeod et al. (2009). Visual examination of the frequency plots of site areas (see **Figures 2** and **3** for area and distributions of area by site) suggested three distributions of area useful for ranking. Area I (largest; sites >27,800 ha) was arbitrarily assigned 5 points, followed by Area II (229 to 27,800 ha) with 4 points and finally Area III (<229 ha) with 2 points.

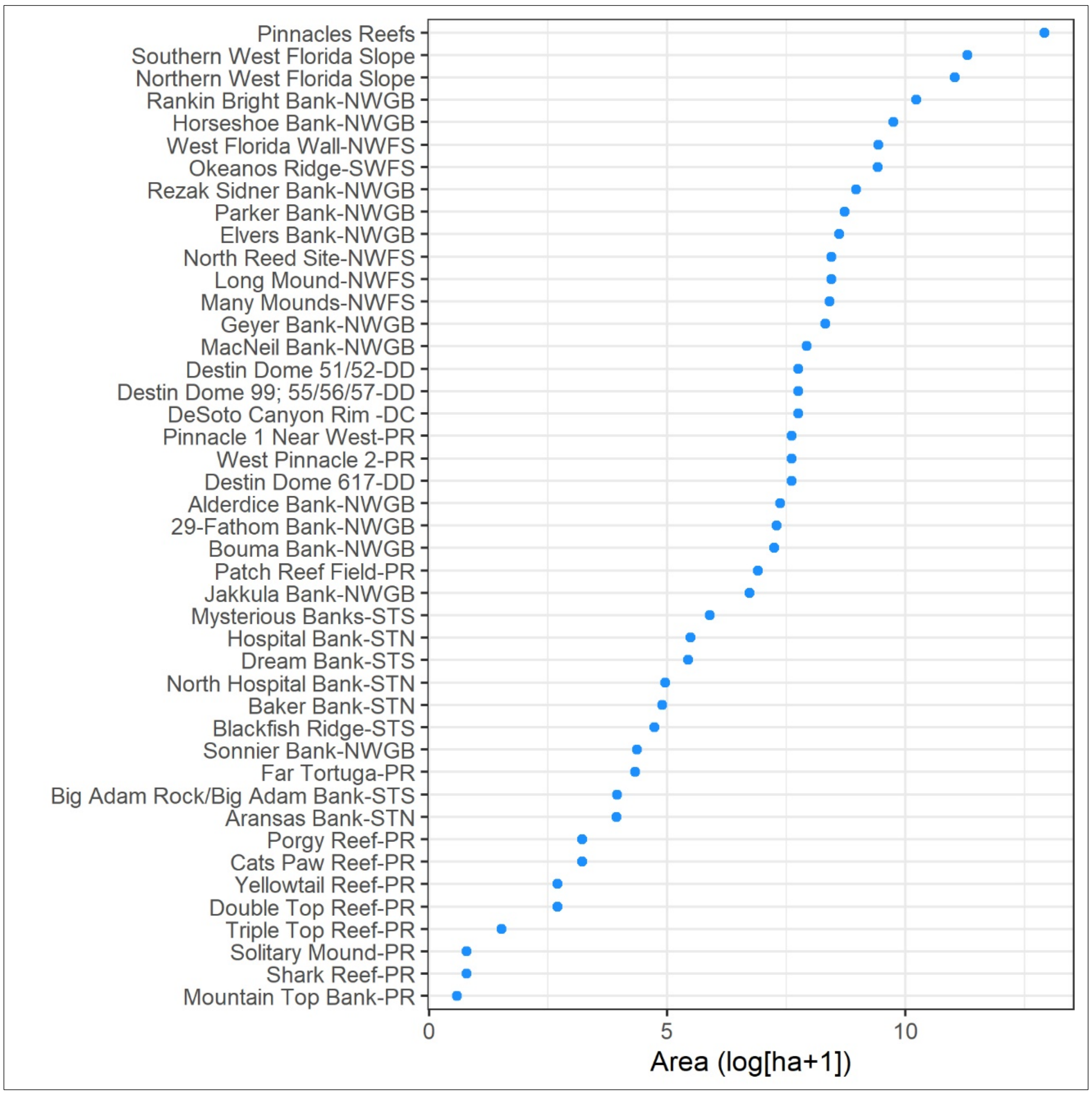

Figure 2. Area (log[ha+1]) for Gulf of Mexico deep reefs. Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS).

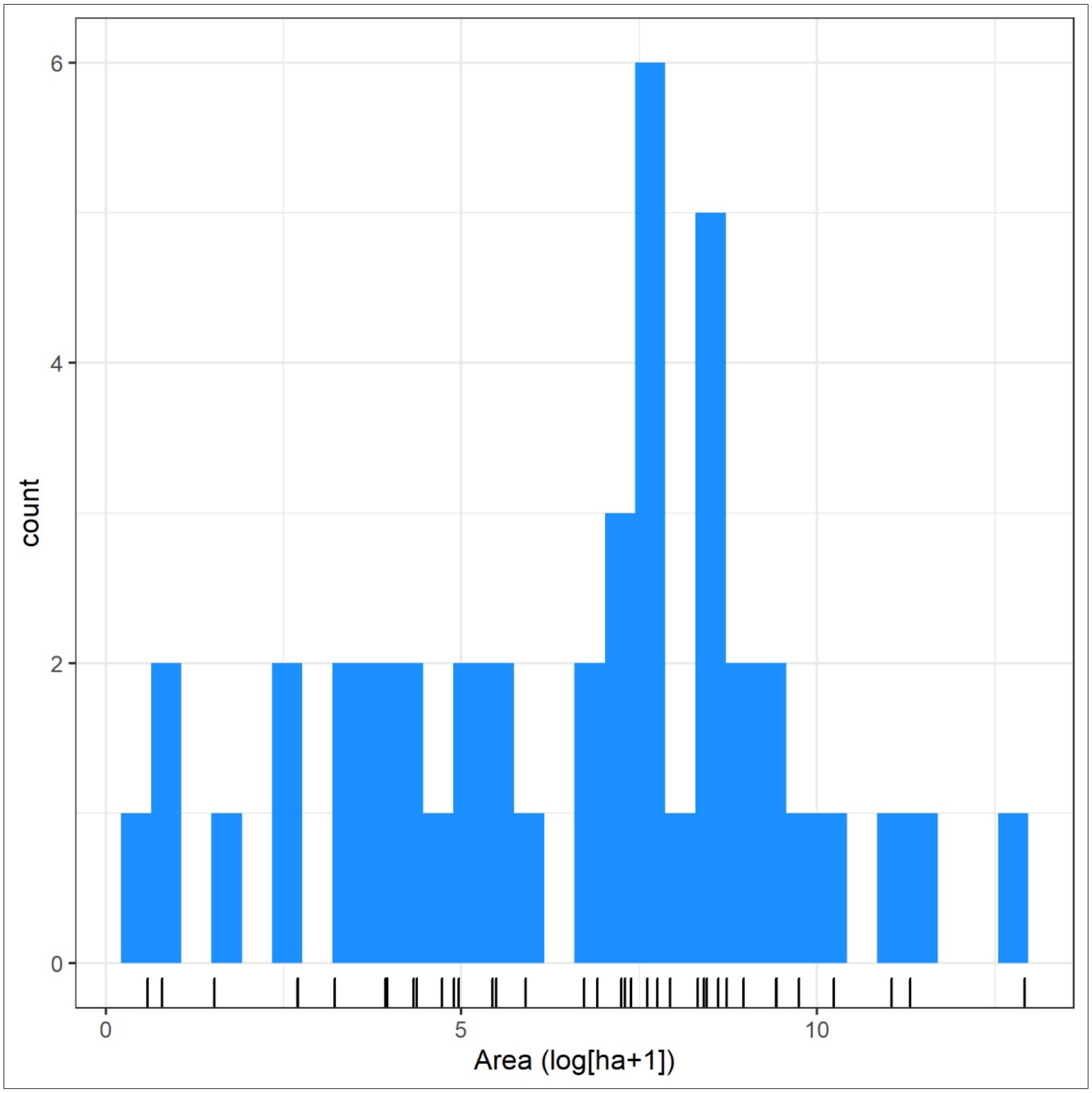

Figure 3. Distribution of area (log[ha+1]) data for Gulf of Mexico deep reefs. Black tick marks along the x axis represent individual deep reefs.

- **Vertical Relief Ranking**: In general, areas with larger physical relief have more biodiversity and perhaps ecological buffering, and thus may be less vulnerable to disease or other impacts. Thus, areas with the greatest relief were ranked highest. Visual examination of the frequency plot of site relief (see **Figures 4** and **5** for vertical relief and distributions of vertical relief by site) was used to assign sites to one of three relief categories. Category I (highest relief) for sites with maximum relief >20 m was assigned 5 points followed by sites with relief between 6 and 20 m (Category II, 4 points), and Category III included sites with relief <6 m (2 points). Note that the frequency plot did not clearly separate Categories I and II, but because of the large range of data and because low and moderate relief should be better defined, we chose the somewhat arbitrary division of 6 m.

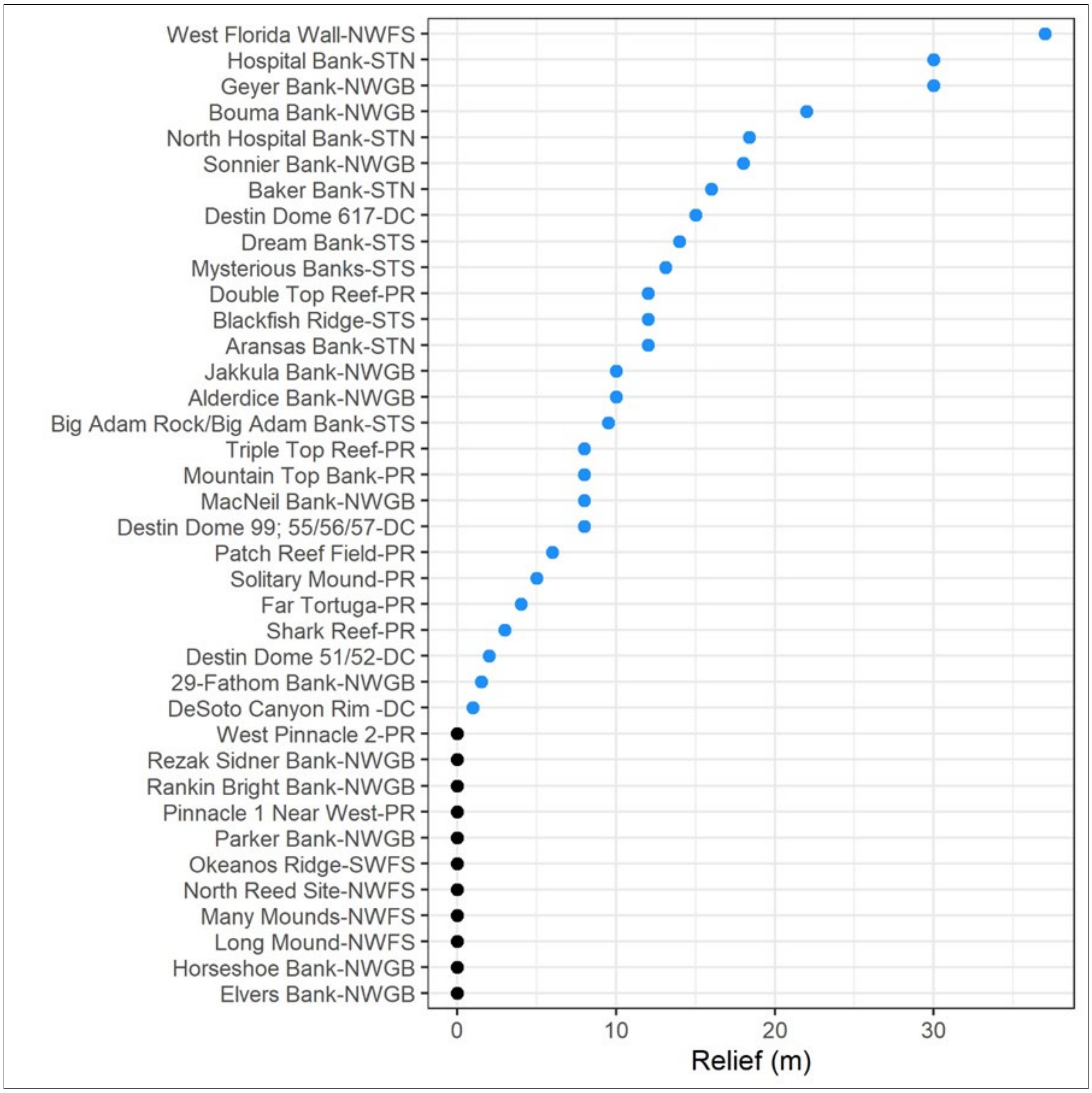

Figure 4. Relief (m) for Gulf of Mexico deep reefs (black symbols indicate missing data). Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS).

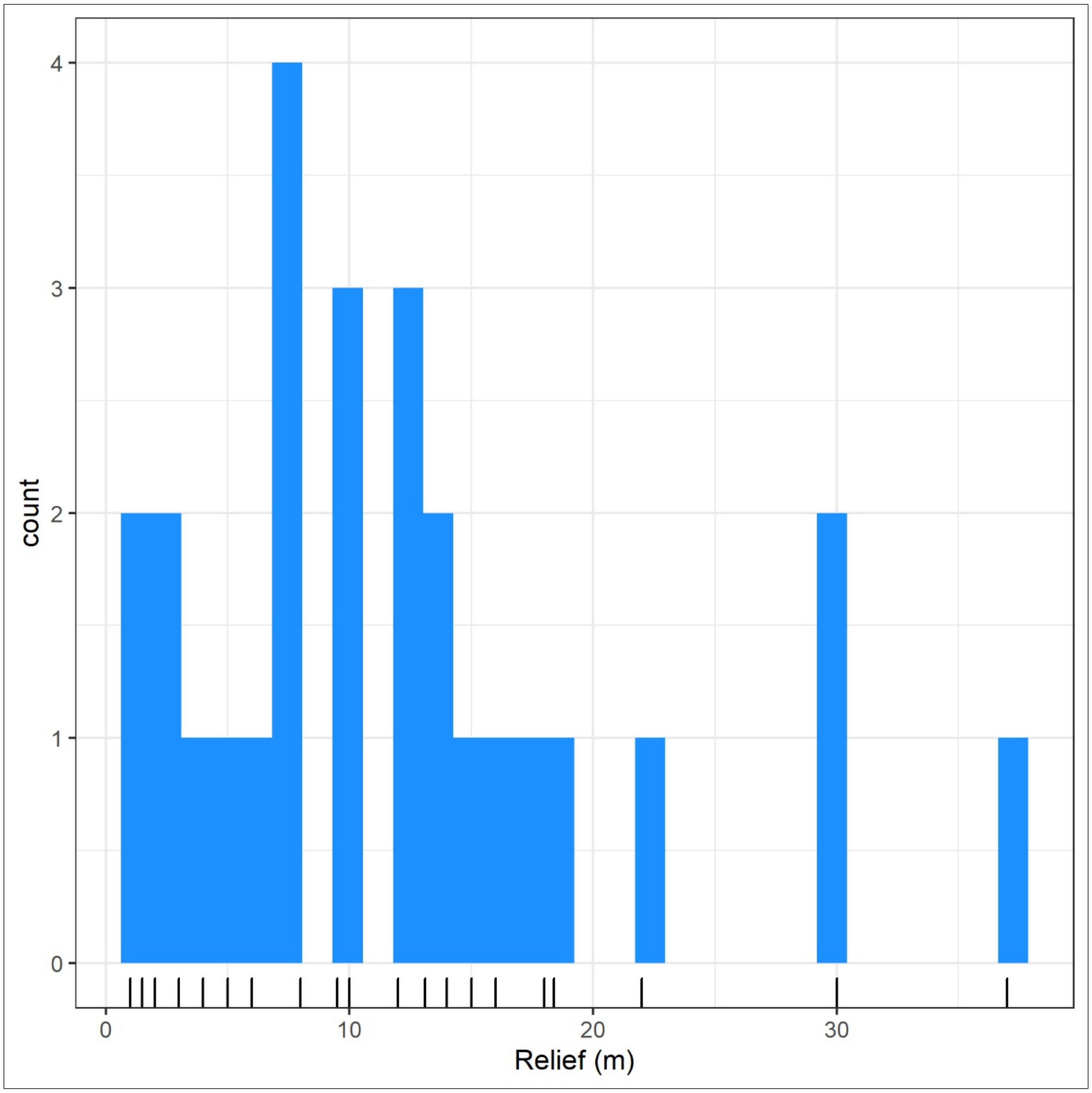

Figure 5. Distribution of relief (m) data for Gulf of Mexico deep reefs. Black tick marks along the x axis represent individual deep reefs.

- **Water Depth Ranking**: While a variety of factors (e.g., species richness) normally change with depth, objective criteria to evaluate the value or ecological impact of depth are lacking. In other words, increasing or decreasing depth are difficult to rank as inherently good or bad. However, in general deeper sites are likely to be more environmentally stable and farther removed from potential impact sources. For this analysis, frequency plots of the depth data (see **Figures 6** and **7** for depth and distributions of depth by site)) revealed two widely separated depth zones (basically "shallow" and "deep"). One point was assigned to Zone I (shallowest, <250 m depth) and 2 points to Zone II (deepest, >500 m depth).

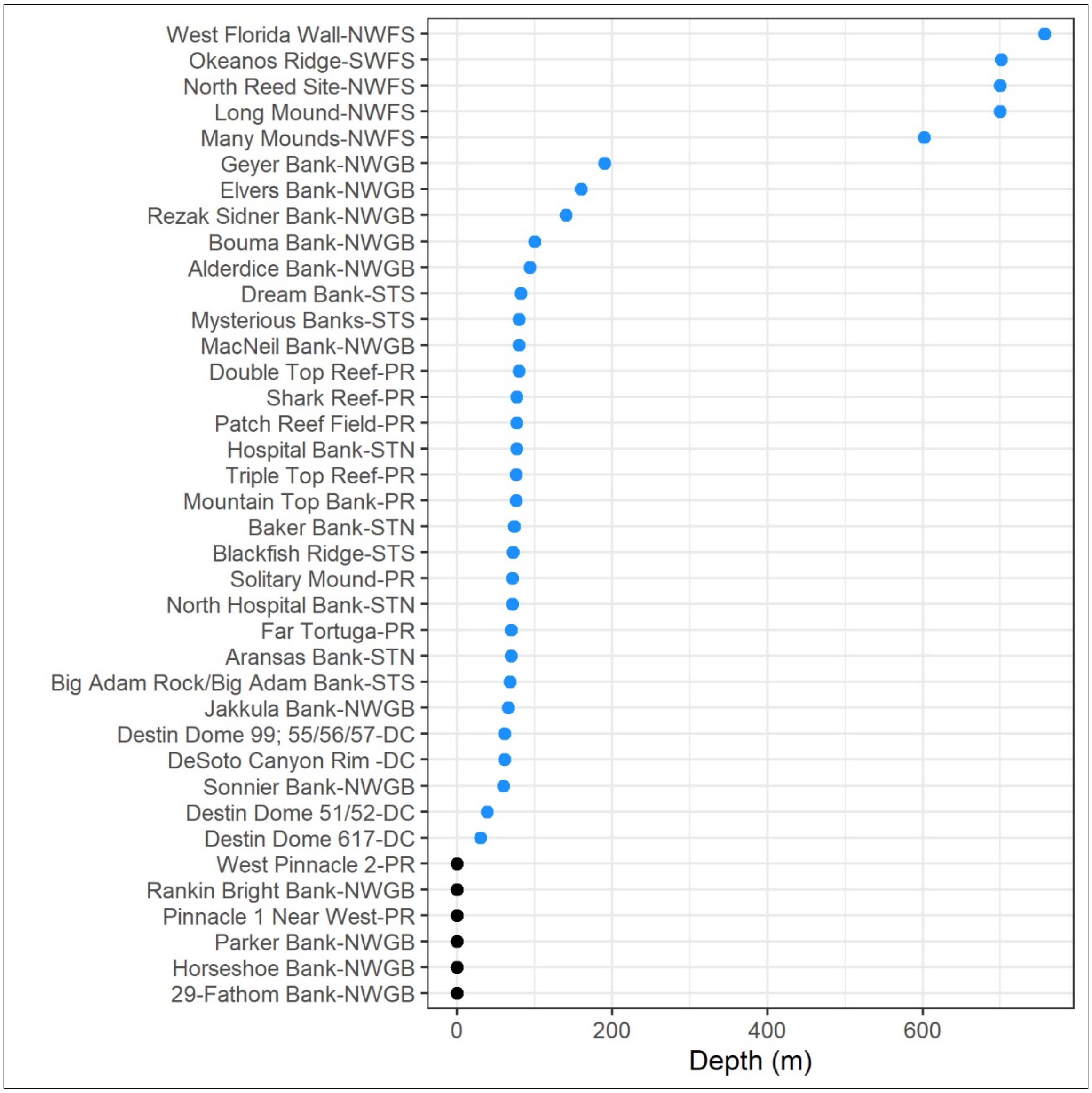

Figure 6. Water depth (m) for Gulf of Mexico deep reefs (black symbols indicate missing data). Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS).

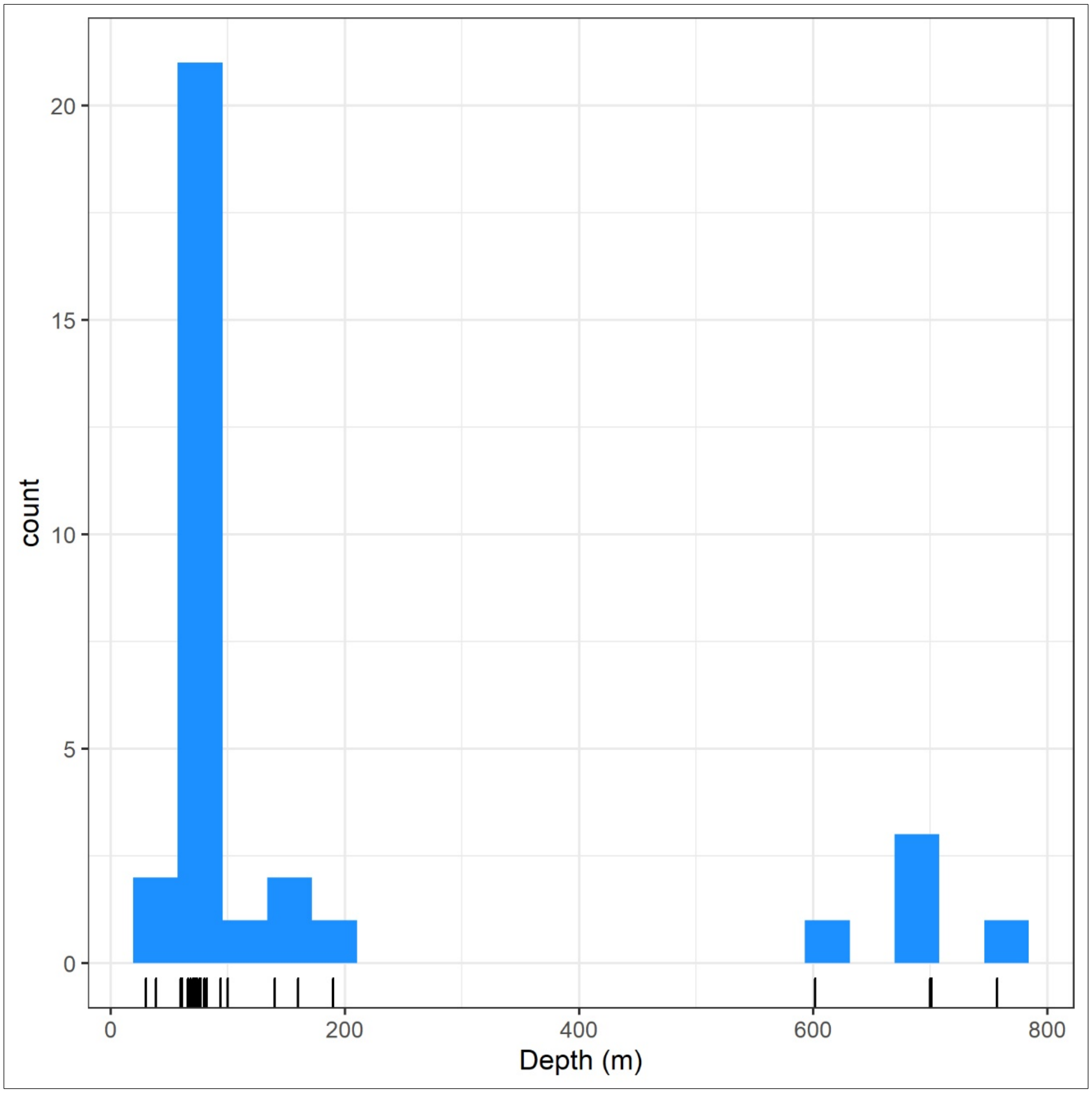

Figure 7. Distribution of depth (m) data for Gulf of Mexico deep reefs. Black tick marks along the x axis represent individual deep reefs.

- **Base Substratum Ranking**: It was assumed that coral substratum had high ecological value but also would be the most vulnerable, and so sites with coral substratum received the most points (5 points). In decreasing order, coral was followed by carbonate rock (3 points), and consolidated sediments such as siltstone (2 points).

- **Temperature Regime Ranking**: We proposed to assign higher rankings to sites with greater temperature stability. Stability (i.e., low variability) is usually correlated with distance from shore, depth, and distance from rivers. For example, sites closer to shore, such as Pinnacles, have greater variability in temperature than sites farther offshore, like Viosca Knoll. However, the highly variable nature of these data and the uncertainty surrounding how they were measured made this factor difficult to evaluate. For now, we decided not to use this factor in rankings.

- **Salinity Regime Ranking**: In general, areas with stability in salinity may be less vulnerable to disease or other impacts. Sites closer to shore and/or near major river systems, such as Pinnacles, have greater variability in salinity than sites farther offshore, like Viosca Knoll. Thus, after all salinities for sites are documented, areas with the smaller salinity range (i.e., less variable) will rank highest. As above, however, the highly variable nature of these data and the uncertainty surrounding how they were measured made this factor difficult to evaluate. For now, we decided not to use this factor in rankings.

- **Proximity to Shore Ranking**: Sites closer to shore have relatively greater variability in environmental conditions and are often closer to sources of impact compared with sites farther offshore. Thus, highest ranking was given to sites farther offshore. Visual examination of the frequency distributions suggested three patterns of shore ranking proximities (see **Figures 8** and **9** for distances and distributions of distances by site). However, because environmental changes occur more rapidly in the areas closer to shore, we divided that category into two sections, arbitrarily divided at 70 km, and we combined all sties beyond 110 km into one group. Category I (<70 km from shore) received one point, Category II (70 to 110 km from shore) received two points, and Category III (>125 km from shore) received 4 points.

- **Proximity to Active Oil/Gas Activity Ranking**: The closer the distance to this activity, the lower the score, and the higher the vulnerability. Frequency distributions of proximity revealed two widely separated data groups (see **Figures 8** and **9** for distances and distributions of distances by site). Because the smaller distance distribution group still represented a wide range of distances, we split the close distance group into two subgroups. Group I (<10 km) was assigned one point, Group II (10 to 80 km) was assigned 3 points and the farthest Group III (>300 km distance) was assigned 5 points.

- **Proximity to Wind Fields or Mining Ranking**: The closer the distance to this activity, the lower the score, and the higher the vulnerability. However, at this time wind energy and ocean mining are not relevant in the GoM, and so these were not ranked.

- **Proximity to Shipping Ranking**: The closer the distance to this activity, the lower the score, and the higher the vulnerability. Most sites were close to (<40 km) or within known shipping lanes and were assigned 1 point. A few sites >50 km from shipping were given 3 points. See **Figures 8** and **9** for distances and distributions of distances by site.

- **Proximity to Nearest Major River Ranking**: Sites closer to river discharges usually have greater variability in environmental conditions and are closer to many sources of impact compared with sites farther offshore. Thus, highest ranking was given to sites farther from river mouths. Visual examination of the frequency plots (see **Figures 8** and **9** for distances and distributions of distances by site) revealed a trimodal distribution, which we used to assign three rank groupings. Group I, closest to river, <110 km, received 1 point, Group II, 110 to 220 km, received 2 points and Group III, >220 km received 3 points.

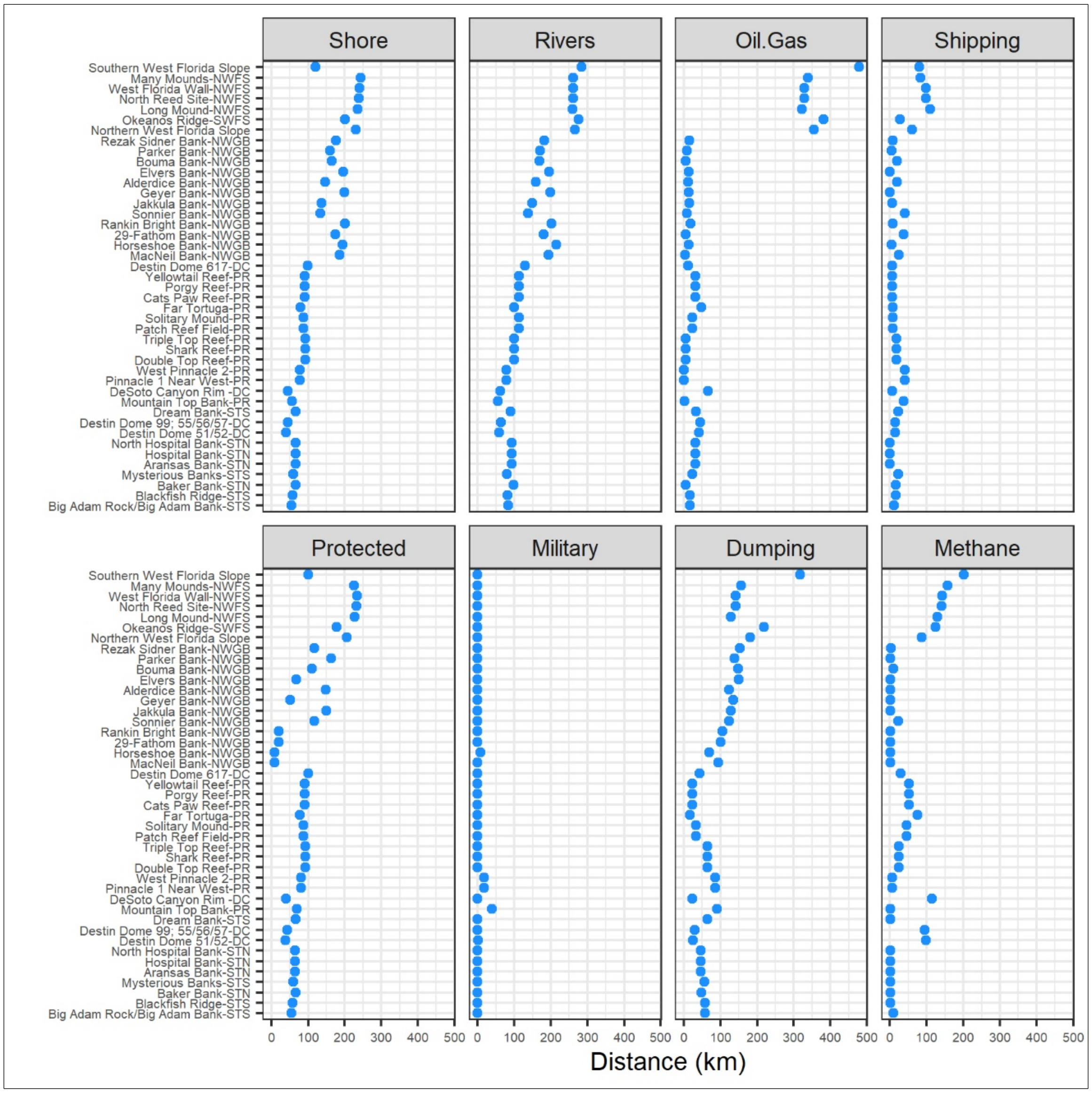

Figure 8. Distance (km) of Gulf of Mexico deep reefs from protected areas, military areas, dumping areas, methane seeps, shore, rivers, oil and gas operations, and shipping lanes. Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS).

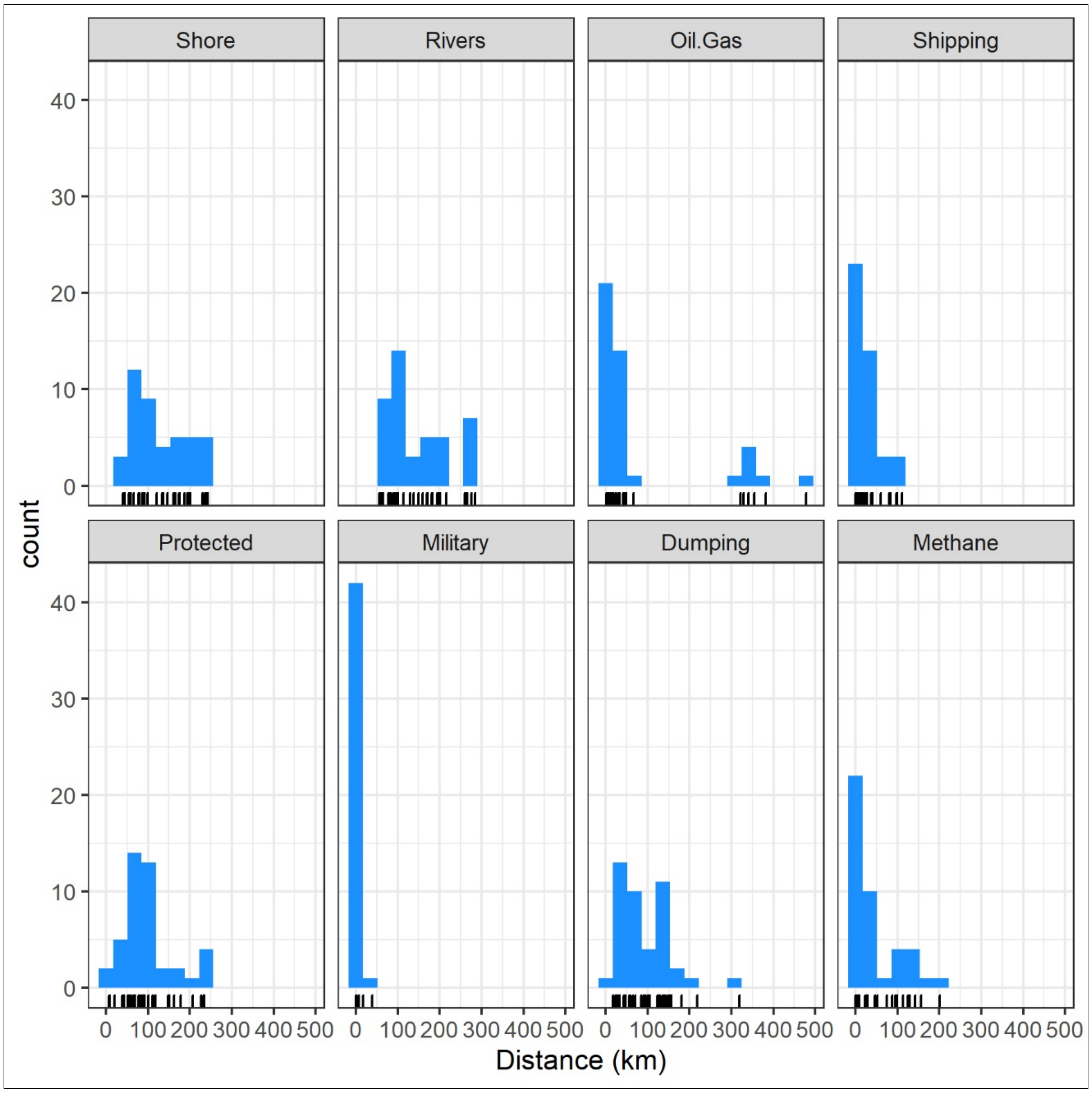

Figure 9. Distribution of distance (km) data of protected areas, military areas, dumping areas, methane seeps, shore, rivers, oil and gas operations, and shipping lanes from selected deep reef sites. Black tick marks along the x axis represent individual deep reefs.

- **Proximity to Other Protected Areas (already designated) Ranking**: Sites closer to locations already receiving protection are more likely to exhibit benefits from that site compared with sites farther from protected areas. Although size of the protected area also has impact, analyzing size as well as distance of these MPAs was beyond the current project scope. Thus, the closer the site to such areas the higher the ranking. Visual inspection of the frequency plots (see **Figures 8** and **9** for distances and distributions of distances by site) indicated three main categories as follows: Group I (<50 km) was given 5 points, Group II (50 to 120 km) 3 points and Group III (>130 km) zero points.

- **Proximity to Consistent Military Operations Ranking**: Because military associated operations may increase probabilities for negative impacts, the closer the distance to this activity, the lower the score, and the higher the vulnerability. Frequency distributions (see **Figures 8** and **9** for distances and distributions of distances by site) indicated that most of these sites were close to or within some type of military operation. One reason for this is that the designated military areas are often very large. The nature of these data did not allow determination of details about the operations (e.g., type of operation, frequency, duration, exact locations), and so ranking was problematic. The most conservative approach was not to use this factor for ranking until more detail could be acquired.

- **Proximity to Dumping Areas (military, hazardous wastes, municipal, etc.) Ranking**: The closer the distance to this activity, the lower the score, and the higher the vulnerability. Visual inspection of the frequency plots (see **Figures 8** and **9** for distances and distributions of distances by site) suggested three possible categories assigned as follows: Group I (<50 km from dumping) was given one point, Group II (50 to 150 km) 3 points and Group III (>150 km) 5 points.

- **Proximity to Benthic Methane Seeps Ranking**: There are few, if any, known detrimental effects for coral or reef communities being in proximity to methane seeps. In fact, some research has suggested that being near such areas may enhance benthic productivity and provide additional structured habitats, such as authigenic carbonate. For this project, it was assumed that being closer to methane seeps provides some environmental and/or structural enhancement and so has higher value. There were two major distributions of the distance frequencies (see **Figures 8** and **9** for distances and distributions of distances by site), but because the closer group represented a wide range of distances and would have higher probability impacts, it was subdivided into two groups for a total of three groups. Group I (<10 km) was assigned 5 points, Group II (10 to 50 km) received 3 points and Group III (>80 km) was likely too far away to impact any site and so was not given any points.

- **Scleractinian Coral Species Richness Ranking**: The greater number of structure-forming species or taxa, the higher the score and the lower the vulnerability (see **Figures 10** and **11** for species richness and distribution of richness by site). Although, as with the fishes (see below), this factor could be assessed for different depth ranges, for now we examined it over the whole depth range. Visual inspection of the distribution figures suggested 3 major species richness groupings. Group I with numbers of species >15 was assigned 5 points. Group II (5to 10 species) was assigned 4 points, and Group III (1 to 4 species) was assigned 3 points.

- **Octocoral Species Richness Ranking**: The greater number of species or taxa, the higher the score and the lower the vulnerability. (see **Figures 10** and **11** for species richness and distribution of richness by site). Visual examination of the species richness distributions suggested three groupings. Group I with >20 species was assigned 5 points. Group II with 7 to 19 species was assigned 4 points, and Group III with <7 species was given 3 points.

- **Hydrozoan (Orders Milleporina and Stylasterina) Species Richness Ranking**: The greater number of species or taxa, the higher the score and the lower the vulnerability. We found hydrozoan data for 16 sites; however, these data seemed incomplete or lacking in general. Thus, this factor was not used at this time for site comparisons.

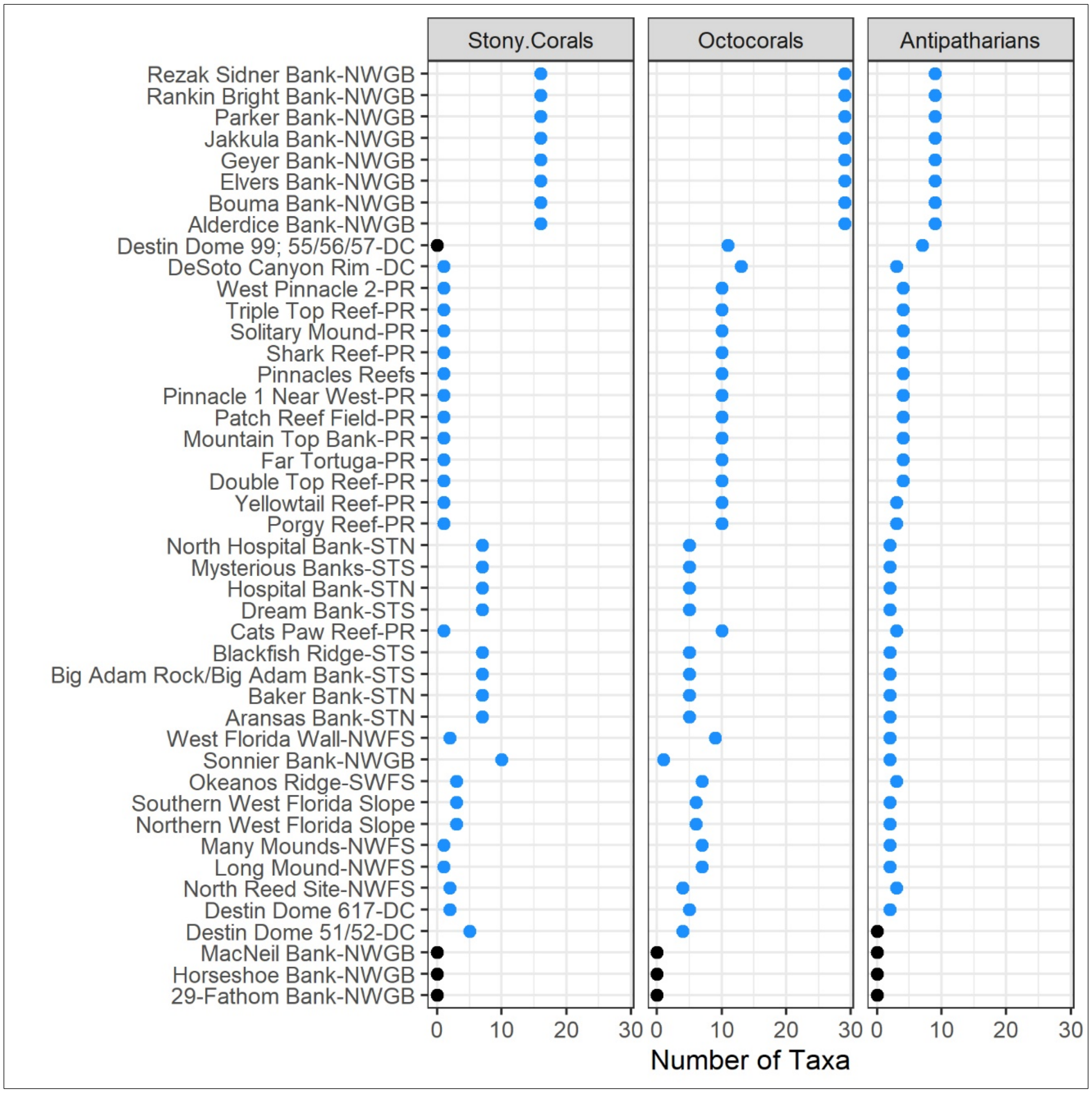

Figure 10. Scleractinian coral, octocoral, and antipatharian species richness (number of taxa) for Gulf of Mexico deep reefs (black symbols indicate missing data). Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS).

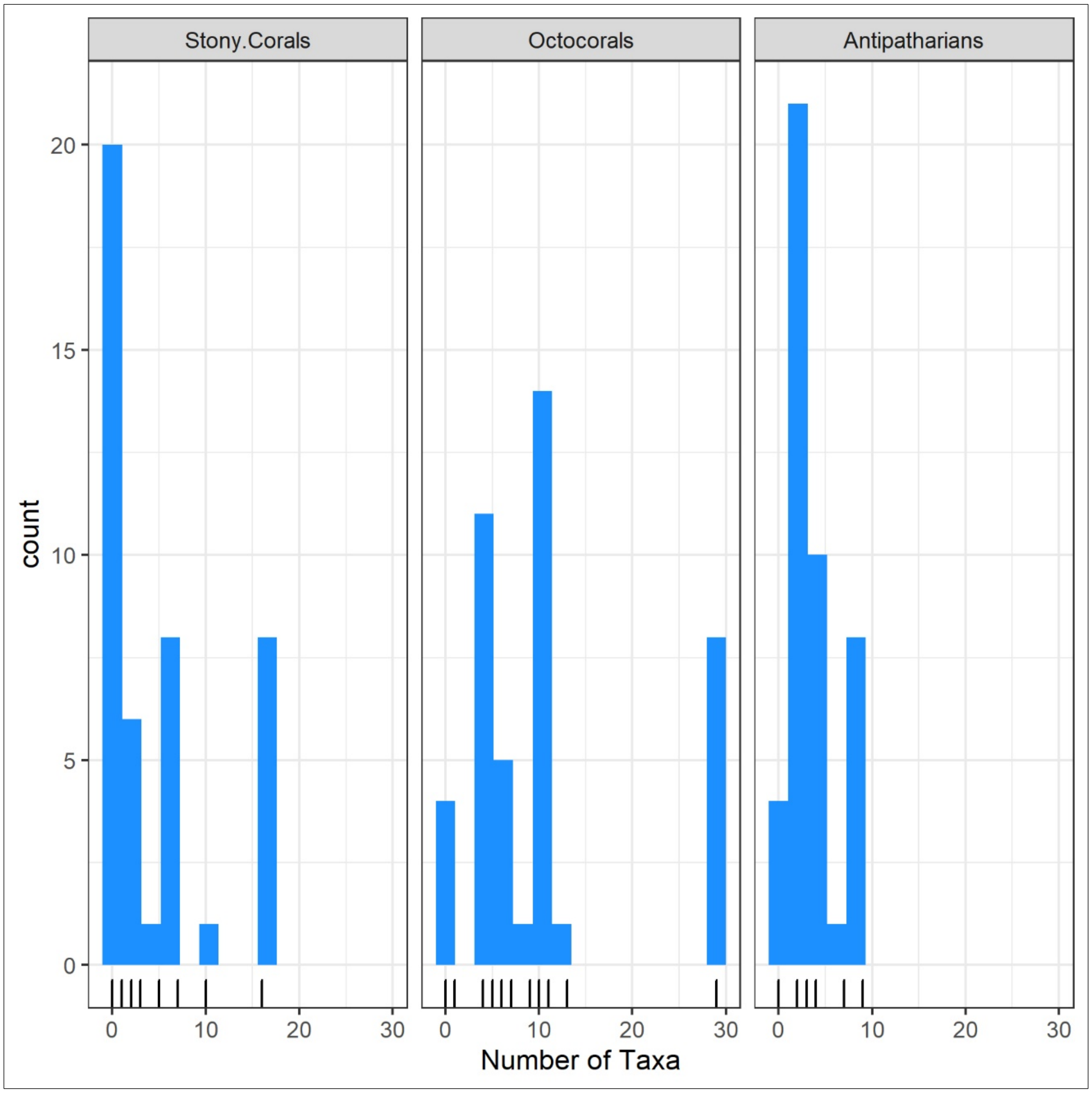

Figure 11. Distribution of stony coral, octocoral, and antipatharian species richness (number of taxa) data. Black tick marks along the x axis represent individual deep reefs.

- **Anthipatharian Species Richness Ranking**: The greater number of species or taxa, the higher the score and the lower the vulnerability(see **Figures 10** and **11** for species richness and distribution of richness by site). Based on the species richness distributions by site, we assigned sites having data to one of 3 groups. Group I with >6 species was given 4 points. Group II with 3 to 6 species was assigned 3 points and Group III with <3 species was given 2 points.

- **Fish Species Richness Ranking**: The greater number of species or taxa, the higher the score and the lower the vulnerability. Because depth zones play a major role in deep reef fish species community structure (Ross and Quattrini, 2007; Ross et al., 2015), fish species richness was ranked within two depth zones: mesophotic (<200 m depth) and deep-sea (>200 m depth). (see **Figures 12** and **13** for species richness and distribution of richness by site and depth zone). For the deep zone, there was only one data set and so all sites in that range received 5 points. For the shallower zone, visual examination of distribution graphs suggested three groupings may be appropriate. Group I with species richness of 30 to 50 species was assigned 5 points; Group II between 20 to 29 was assigned 4 points and richness <20 was assigned 3 points.

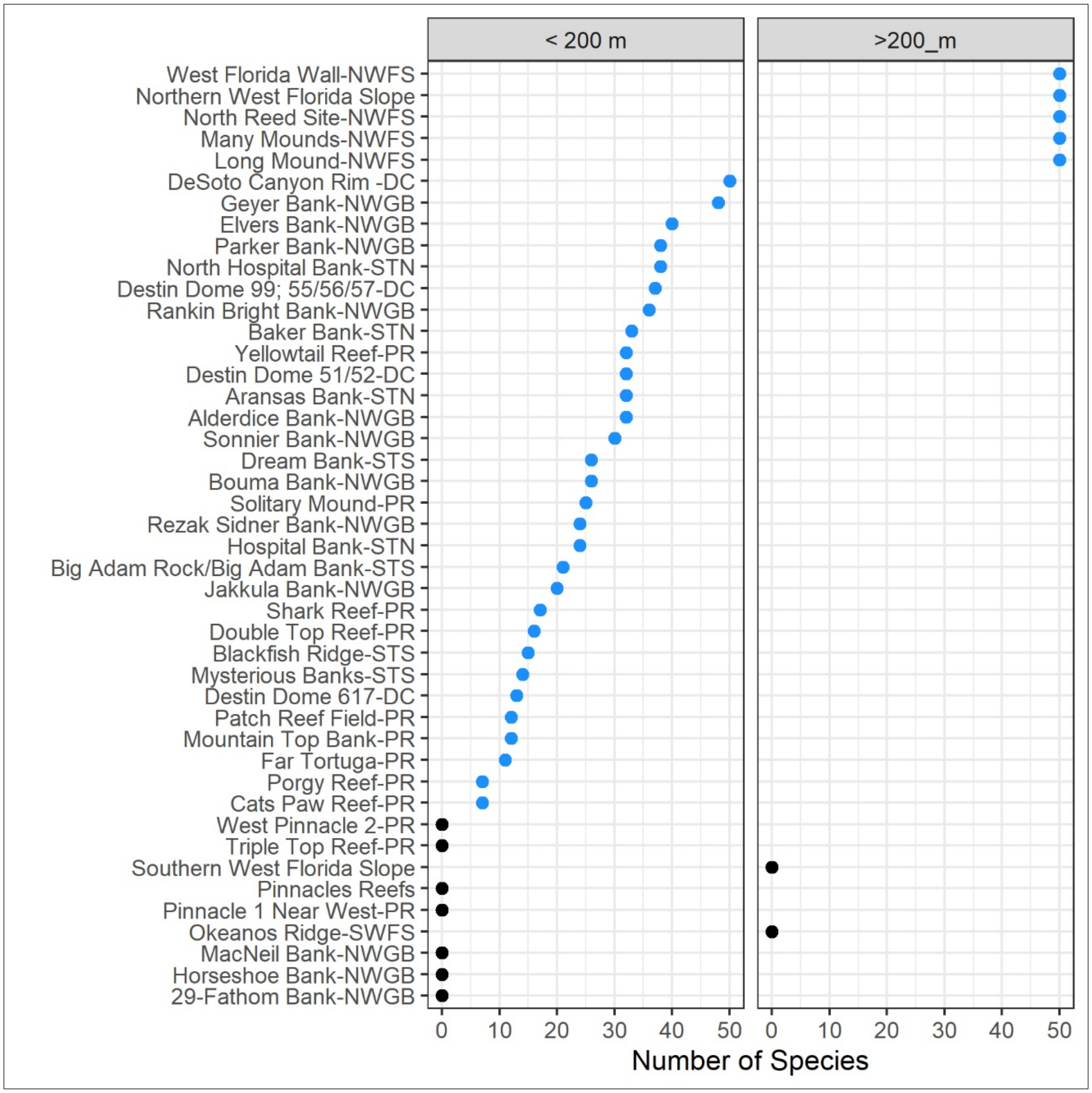

Figure 12. Fish species richness (number of taxa) for Gulf of Mexico deep reefs within two depth zones: mesophotic (<200 m depth) and deep-sea (>200 m depth) (black symbols indicate missing data). Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS).

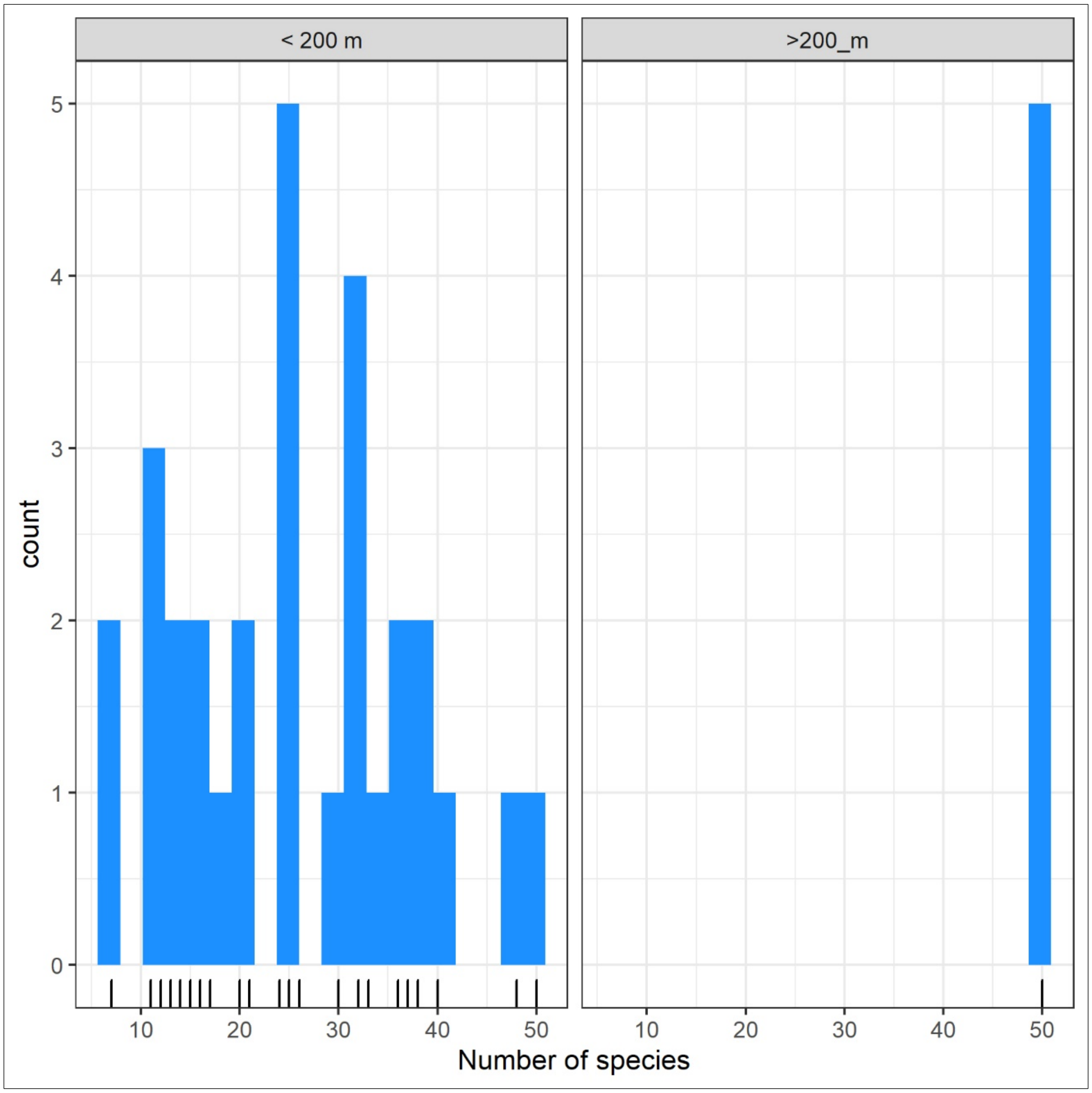

Figure 13. Distribution of fish species richness (number of taxa) data for Gulf of Mexico deep reefs within two depth zones: mesophotic (<200 m depth) and deep-sea (>200 m depth). Black tick marks along the x axis represent individual deep reefs.

- **Bottom Longline (Reef Fish) Fishing Activity/Intensity Ranking:** Estimates of the frequency/intensity of the bottom longline (BLL) gear for reef fishes (derived from Clark et al., 2018) was considered in rankings. For example, the highest impact (lowest ranking) within the site boundary (proximity) that is continuous with high intensity (frequency/intensity) (see **Figures 14** and **15** for estimated BLL fishing intensity and distribution of intensity by site). Eleven sites either supported no BLL fishing activity or there were no data, and it was not possible to determine which was the case. We assumed no activity and assigned 5 points for that case. Sites with 1 to 1,000 VMS counts were assigned 4 points, sites from 1,001 to 2,000 received 3 points and those with counts greater than 2000 received 0 points.

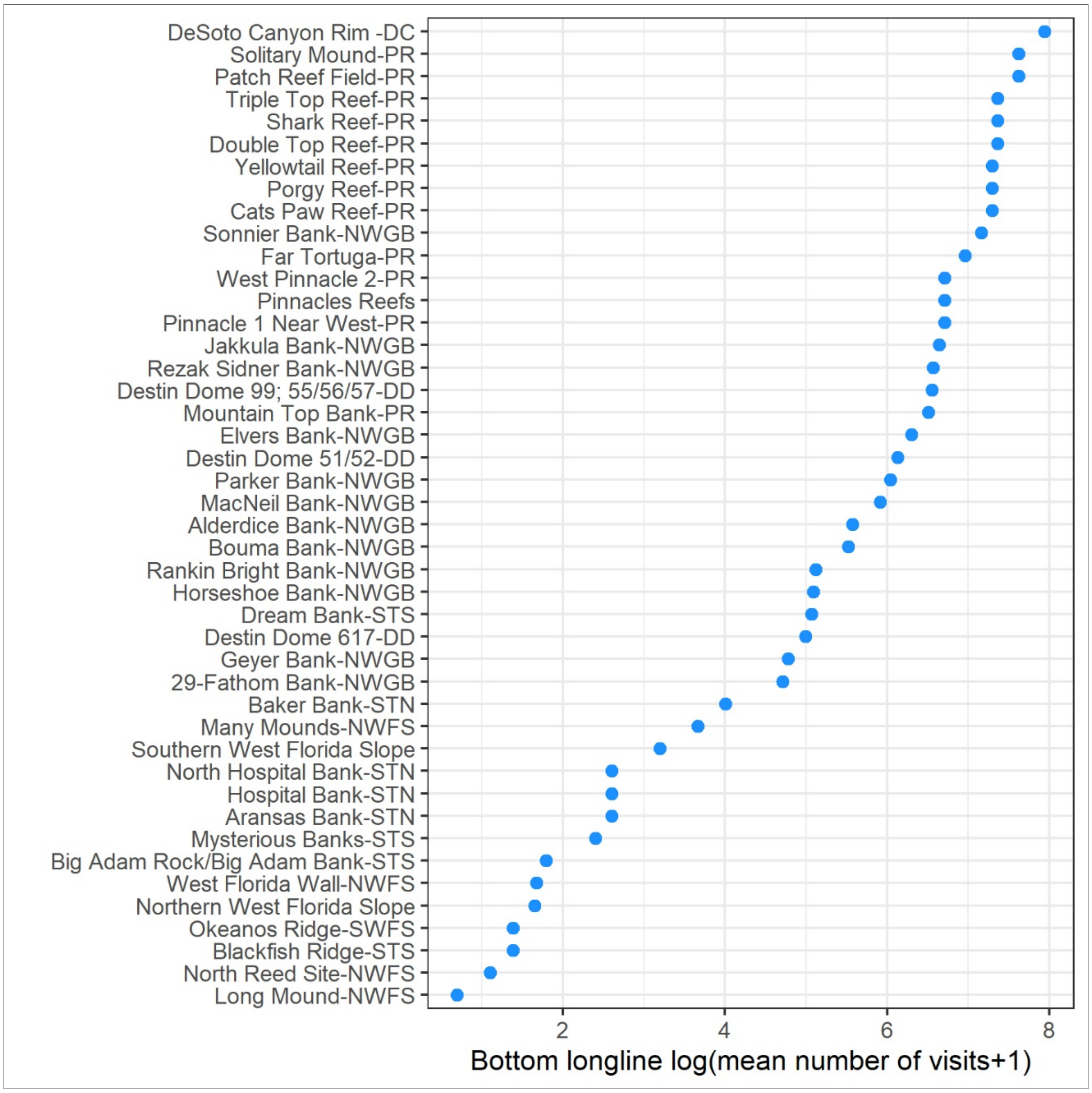

Figure 14. Bottom longline fishing activity (vessel monitoring system counts) for spatial grids encompassing Gulf of Mexico deep reefs (from Clark et al., 2018). Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB),

South Texas Banks North (STN), South Texas Banks South (STS). (Source: Gulf of Mexico Fishery Management Council, 2021).

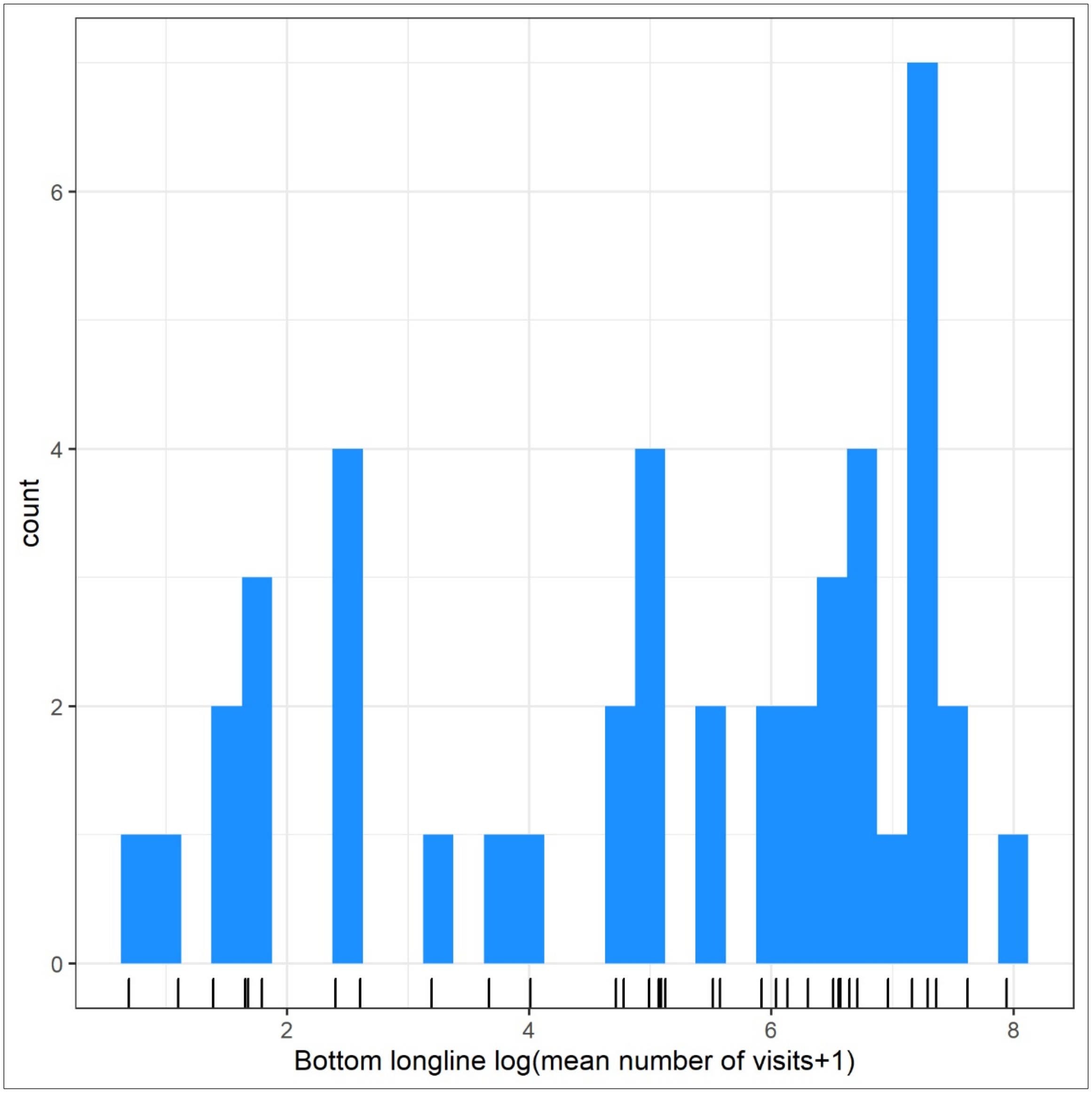

Figure 15. Distribution of bottom longline fishing activity (vessel monitoring systems counts) for Gulf of Mexico deep reefs (from Clark et al., 2018). Black tick marks along the x axis represent individual deep reefs.

- **Bottom Trawling Activity:** Distribution graphs of mean bottom trawling hours by site (derived from Clark et al., 2018) illustrated three separate groups of data (see **Figures 16** and **17** for trawling hour intensity and distribution of intensity by site). Group I with hours >3,000 hrs was assigned 1 point. Group II with hours between 50 to 3,000 hrs was assigned 2 points, and Group III with mean hours from 1 to 50 was assigned 3 points. We assumed sites with no data had no apparent bottom trawl activity and these were given 4 points.

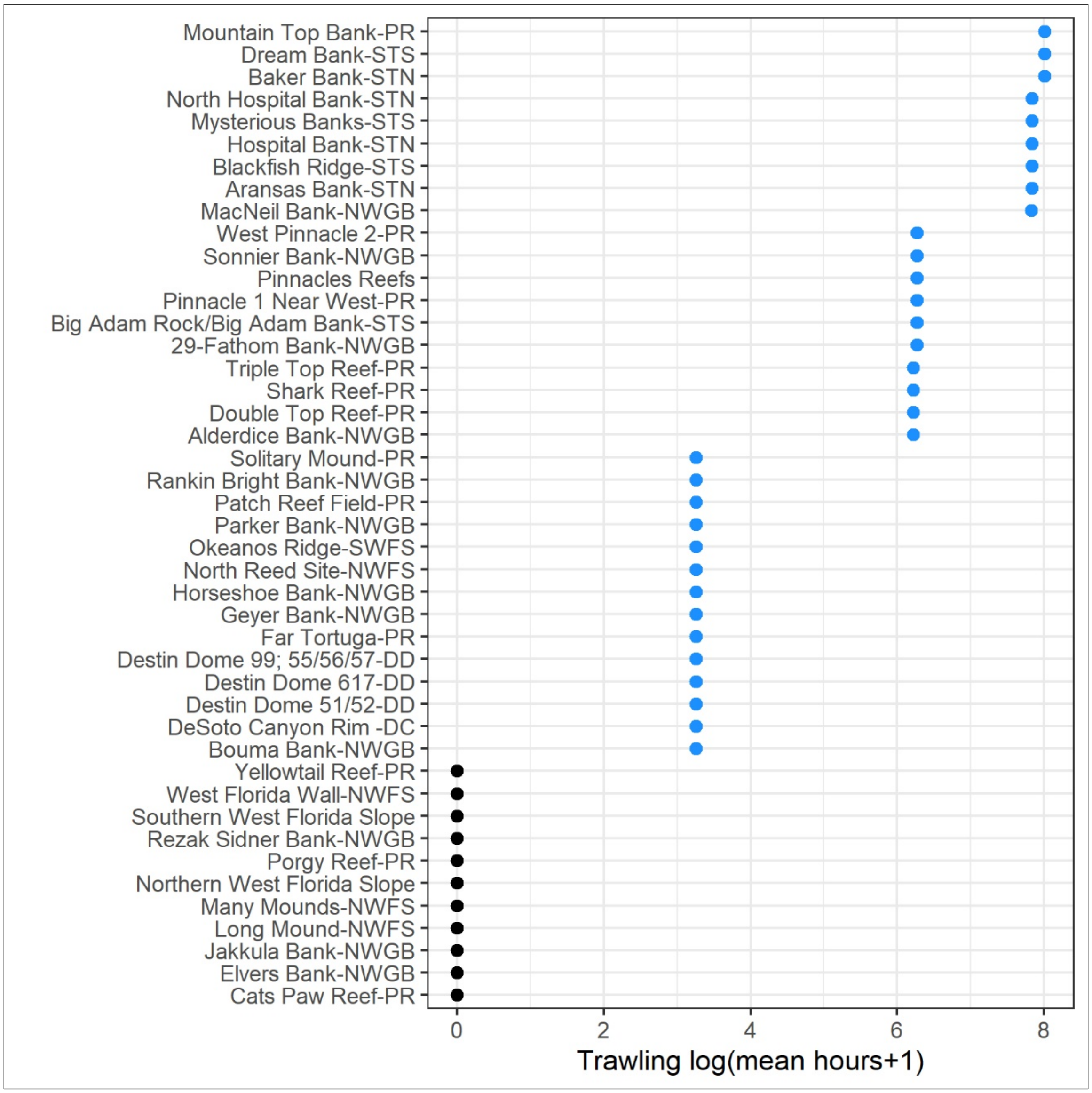

Figure 16. Bottom trawl fishing activity (vessel hours) within spatial grids encompassing Gulf of Mexico deep reefs (from Clark et al., 2018). Black dots indicate areas with no trawl fishing data. Area abbreviations are as follows: Northern West Florida Slope (NWFS), Southern West Florida Slope (SWFS), Pinnacles Reef (PR), DeSoto Canyon (DC), Northwestern Gulf of Mexico Banks (NWGB), South Texas Banks North (STN), South Texas Banks South (STS). (Source: Gulf of Mexico Fishery Management Council, 2021).

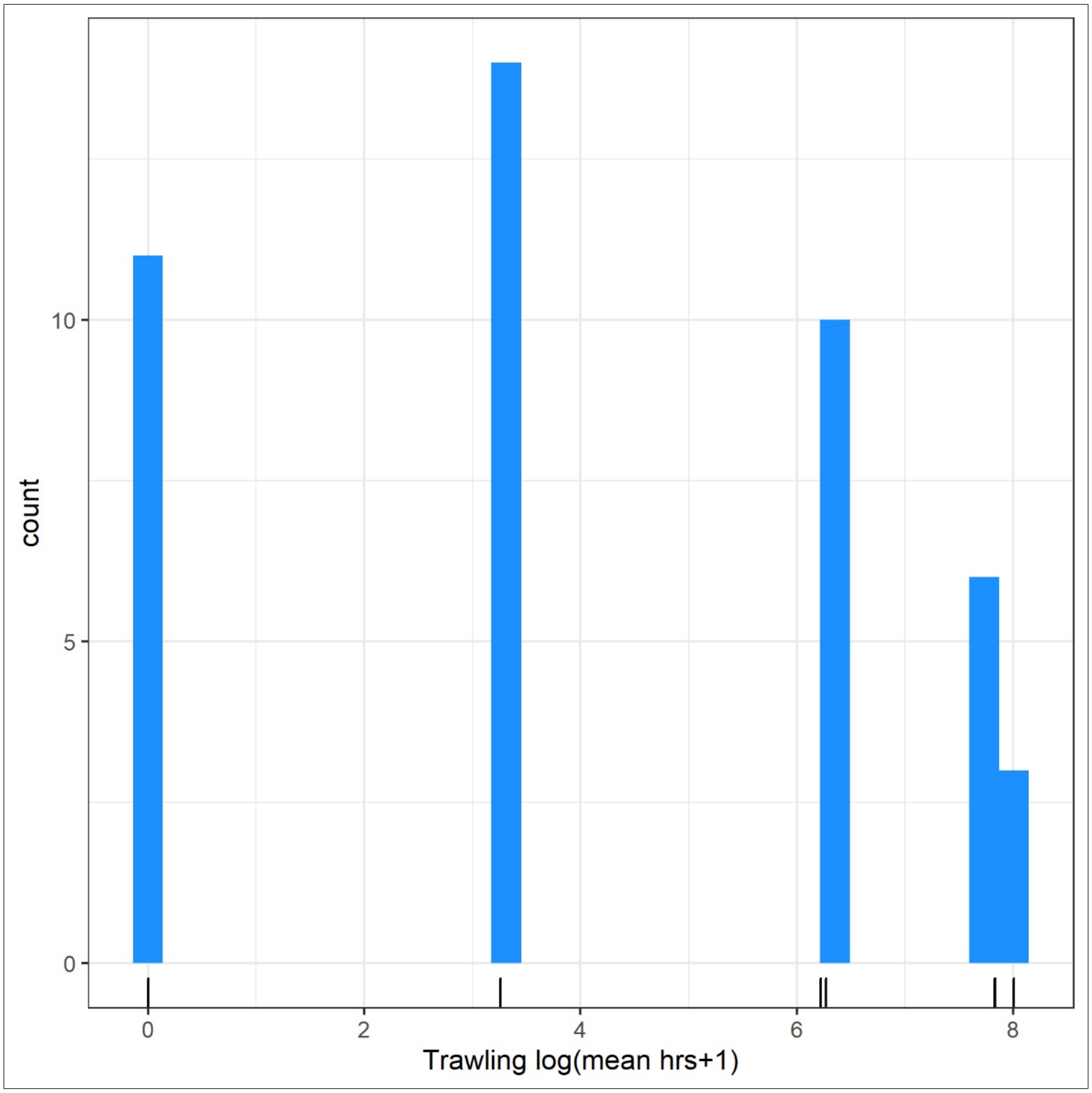

Figure 17. Distribution of benthic trawl fishing activity (vessel hours) for Gulf of Mexico deep reefs (from Clark et al., 2018). Black tick marks along the x axis represent individual deep reefs.

- **Invasive Species Ranking**: The higher the number of invasive species the higher the potential negative impact and the lower the ranking score. This category has limited data; however, we selected an arbitrary ranking criterion where sites without known invasive species received one point while sites with any reported invasive species received no points.

- **Disease Incidence Ranking**: Greater incidence of disease is considered to have higher negative impact and thus lower ranking score. This category also has limited data. We selected an arbitrary ranking criterion where sites without known coral diseases received one point while sites with any reported coral diseases received no points.

- **Research History Ranking**: Greater amounts of research data in general should lead to better understanding of a site's ecological value and its potential vulnerability. Available literature from CSA's literature search was used as a proxy for amount and quality of data. Higher scores went to sites with the most extensive and highest quality research. References were categorized in order of importance as peer-reviewed, graduate thesis/dissertation, agency report, or miscellaneous grey literature (**Table 3**). These categories were used to weight the literature frequencies. The number of peer-reviewed references for a site was multiplied by 4, graduate degree literature (Masters and PhD) was multiplied by 3, agency reports by 2 and other grey literature was not weighted (**Table 3**). This factor was assigned a qualitative descriptor based on the number and type of publications found for each site in CSA's literature search as follows: Extensive (5 points) if total weighted numbers of references was >33 , Moderate (4 points) if total weighted numbers of references equaled 10 to 32, Low (2 points) if total weighted numbers of references was <10, or None (0 points) if there was no research recorded for the site.

- **Current Protections Ranking**: Sites that currently have some degrees of protection or special management, in general have already received some assessment activity and protections. Such sites were assigned a higher ranking (3 points) than those sites without protections (0 points).

- **Vulnerability to Climate Change Ranking**: The higher the vulnerability to climate change, the lower the ranking. While this is an important factor that should be considered, data gathered in this exercise were either lacking or not appropriate to access climate change. Although not used at this time for site comparisons, this factor is retained in the matrix for future evaluation.

2.2 GEODATABASE

Spatial data obtained during the data search and review task were presented in geodatabase format using templates provided by Council staff. The geodatabase was created in Esri ArcMap Version 10.8 and included the selected project sites as a polygon feature class ("CoralSitesPolygon") and the site or polygon centers as a point feature class ("CoralSiteCentersPoint"). Both features include all the factor measurements calculated during the study. The data are in WGS 84. Federal Geospatial Data Committee (FGDC) compliant metadata are also included.

2.3 WEB-BASED DASHBOARD

A web-based dashboard was designed and created to display project-related information to the Council, for decision making, and for outreach purposes. The dashboard was created using the Esri ArcGIS Online (AGOL) Web App Builder and features an interactive map displaying the shape/area and coordinates of the project sites and associated information. The coral sites polygon and the project site centers point features from the geodatabase were published to AGOL as hosted feature services. These data were added to a web map that included a GoM Benthic Communities dataset, a GoM USGS deep sea corals dataset, and a GoM BOEM Bathymetric dataset. This web map was then used to create the dashboard through the Web App Builder. The project sites polygons and site centers point features have "Pop Ups" enabled, which allows users to click on the features and see the attribute information on the screen. Other features of the application include a Legend tool, a Layer List tool, a Drawing Tool, a Print tool, a Measure tool, a Basemap tool, and a Bookmarks tool.

3.0 Results

3.1 ECOLOGICAL ASSESSMENT

3.1.1 Site Selection

After reviewing Coral Amendment 9 (GMFMC, 2018) and other supportive information provided by the Council, a preliminary list of 67 project sites within four major regions of the GoM were proposed for this project. On October 19, 2021, communications between the Council and the CSA Team determined that some proposed reef/bank locations would be eliminated from the project site list because they had already received some level of protection. Endnote citations and PDFs related to these locations were deleted. Listed alphabetically, the deleted sites included:

Region	*Area*	*Site*
SOUTHEASTERN GoM	n/a	Dry Tortugas
		Florida Keys National Marine Sanctuary
		Pulley Ridge
		North Reed Site
NORTHEASTERN GoM	Pinnacles Reefs	Alabama Alps
		L&W Pinnacles
		Rough Tongue Reef
		Scamp Reef
	n/a	Mississippi Canyon 118
		Viosca Knoll 826, 862 and 906
NORTHWESTERN GoM	n/a	AT 047 and 357
		Gardens Banks 299 and 535
		Green Canyon 140, 234, 272, 354 and 852
		Mississippi Canyon 118, 751 and 885
SOUTHWESTERN GoM	n/a	Southern Bank
		Unnamed Bank (Harte Bank)

The final list of sites considered included 44 project sites, which includes three ‘megasites’ (defined as a larger conglomerate of sites which includes a subset of individual project sites) (**Table 2**).

Individual sites and megasites within each of the four GoM Regions are shown below in **Figures 18** to **21**.

Table 2. Selected Project Sites and Megasites.

Region	Area	Site	
		Number	Name
SOUTHEASTERN GoM	Northern West Florida Slope	1	Northern West Florida Slope[1]
		2	North Reed Site
		3	Long Mound
		4	Many Mounds
		5	West Florida Wall
	Southern West Florida Slope	6	Southern West Florida Slope[1]
		7	Okeanos Ridge
NORTHEASTERN GoM	Pinnacles Reefs	8	Pinnacles Reefs[1]
		9	Triple Top Reef
		10	Double Top Reef
		11	Shark Reef
		12	Far Tortuga
		13	Patch Reef Field
		14	Solitary Mound
		15	Mountain Top Bank
		16	Pinnacle 1 Near West
		17	West Pinnacle[2]
		18	Cats Paw Reef[2]
		19	Porgy Reef[2]
		20	Yellowtail Reef[2]
NORTHEASTERN GoM	DeSoto Canyon	21	DeSoto Canyon Rim[2]
	Destin Dome	22	Destin Dome 51/52[2]
		23	Destin Dome 99; 55/56/57[2]
		24	Destin Dome 617[2]
NORTHWESTERN GoM	Shelf-Edge Banks	25	Sonnier Bank
		26	29-Fathom Bank
		27	MacNeil Bank
		28	Alderdice Bank
		29	Bouma Bank
		30	Horseshoe Bank
		31	Rankin Bright Bank
		32	Geyer Bank
		33	Elvers Bank
		34	Rezak Sidner Bank
		35	Parker Bank
		36	Jakkula Bank
SOUTHWESTERN GoM	South Texas Banks - North	37	Baker Bank
		38	Hospital Bank
		39	North Hospital Bank
		40	Aransas Bank
	South Texas Banks - South	41	Dream Bank
		42	Mysterious Banks
		43	Big Adam Rock/Big Adam Bank
		44	Blackfish Ridge

[1] Megasite composed of a set of individual project sites.
[2] Additional sites recommended by the CSA team.

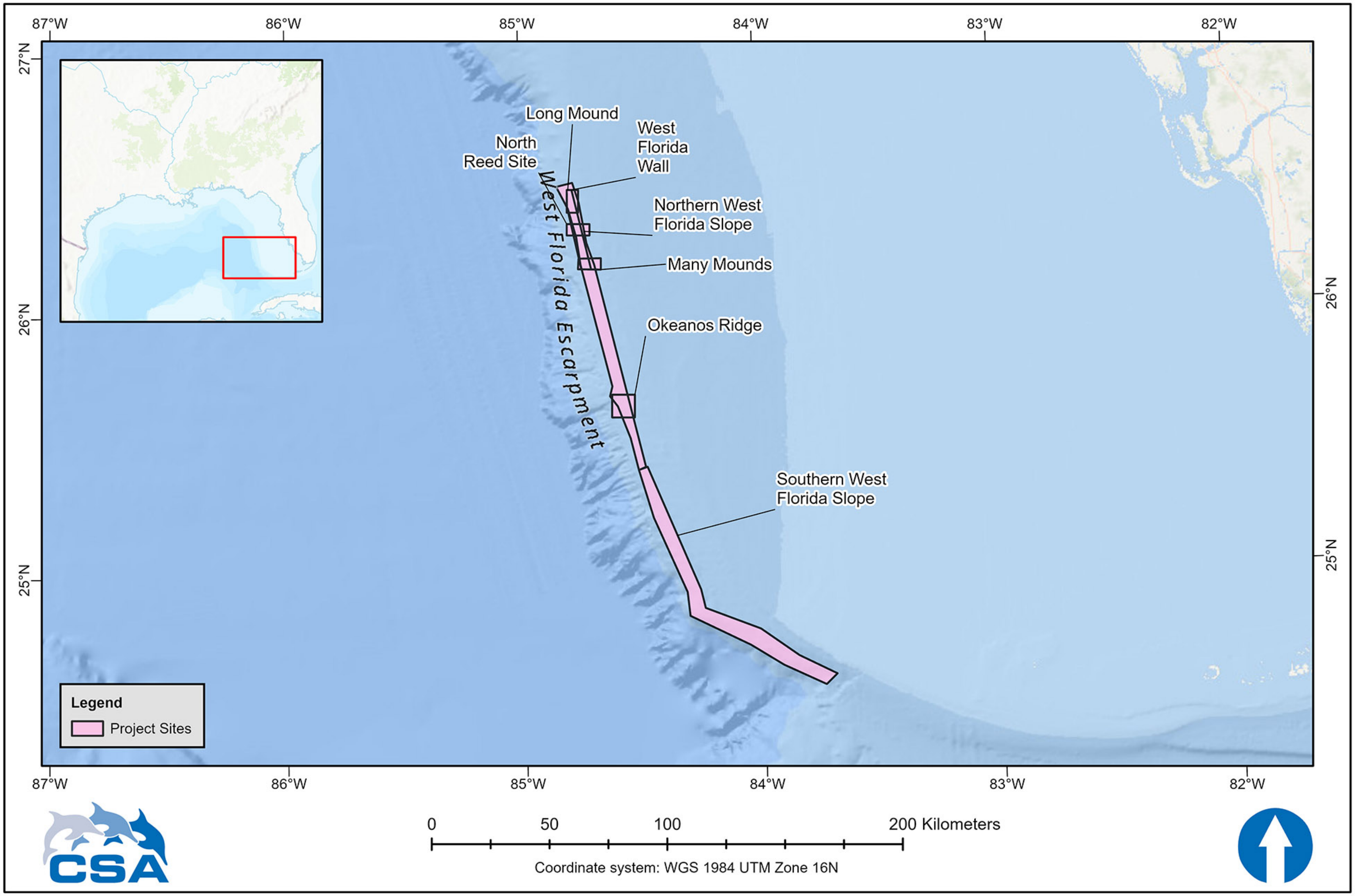

Figure 18. Southeastern GoM Region Project Sites and Megasites selected for this analysis.

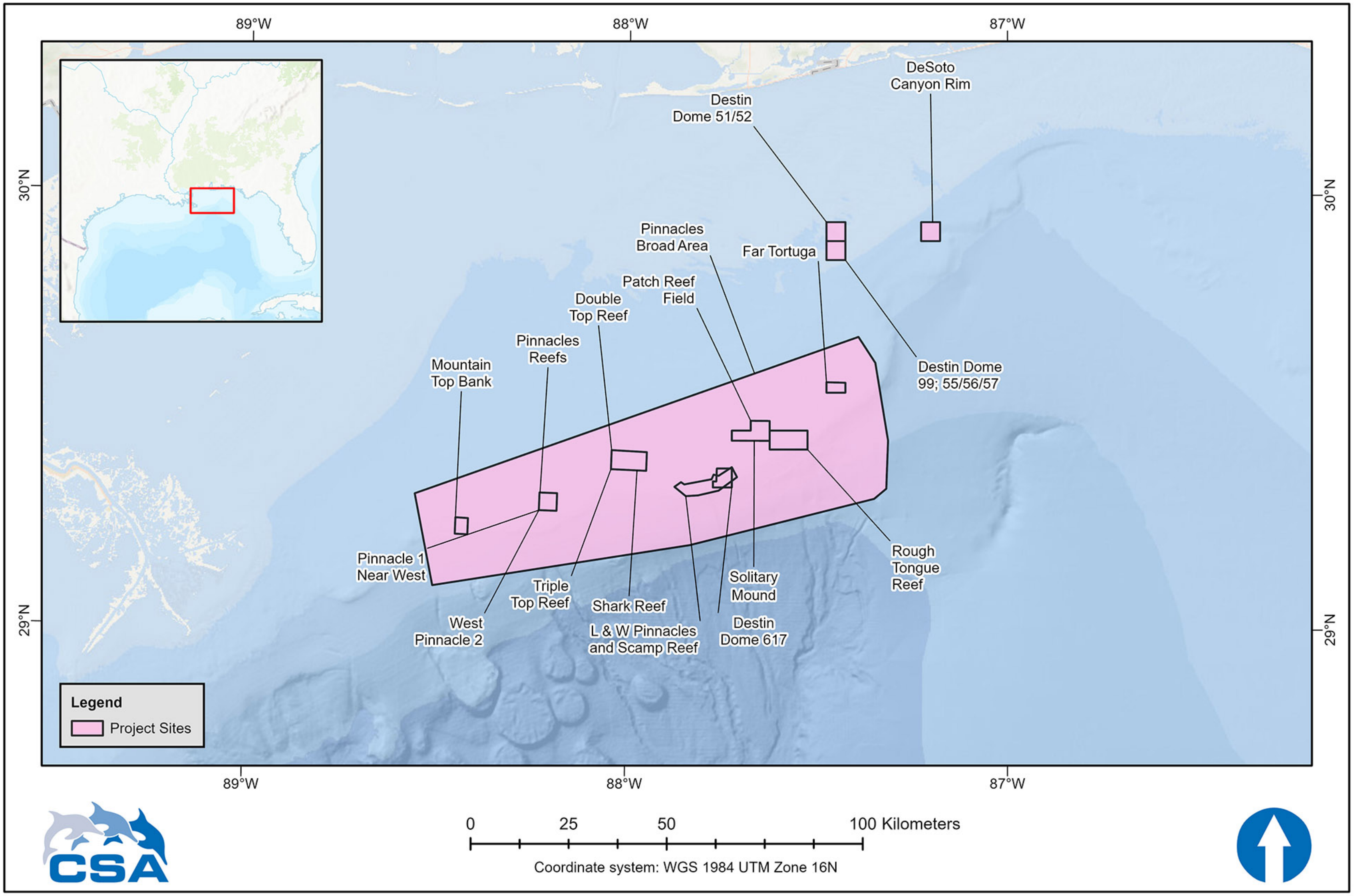

Figure 19. Northeastern GoM Region Project Sites and Megasites selected for this analysis.

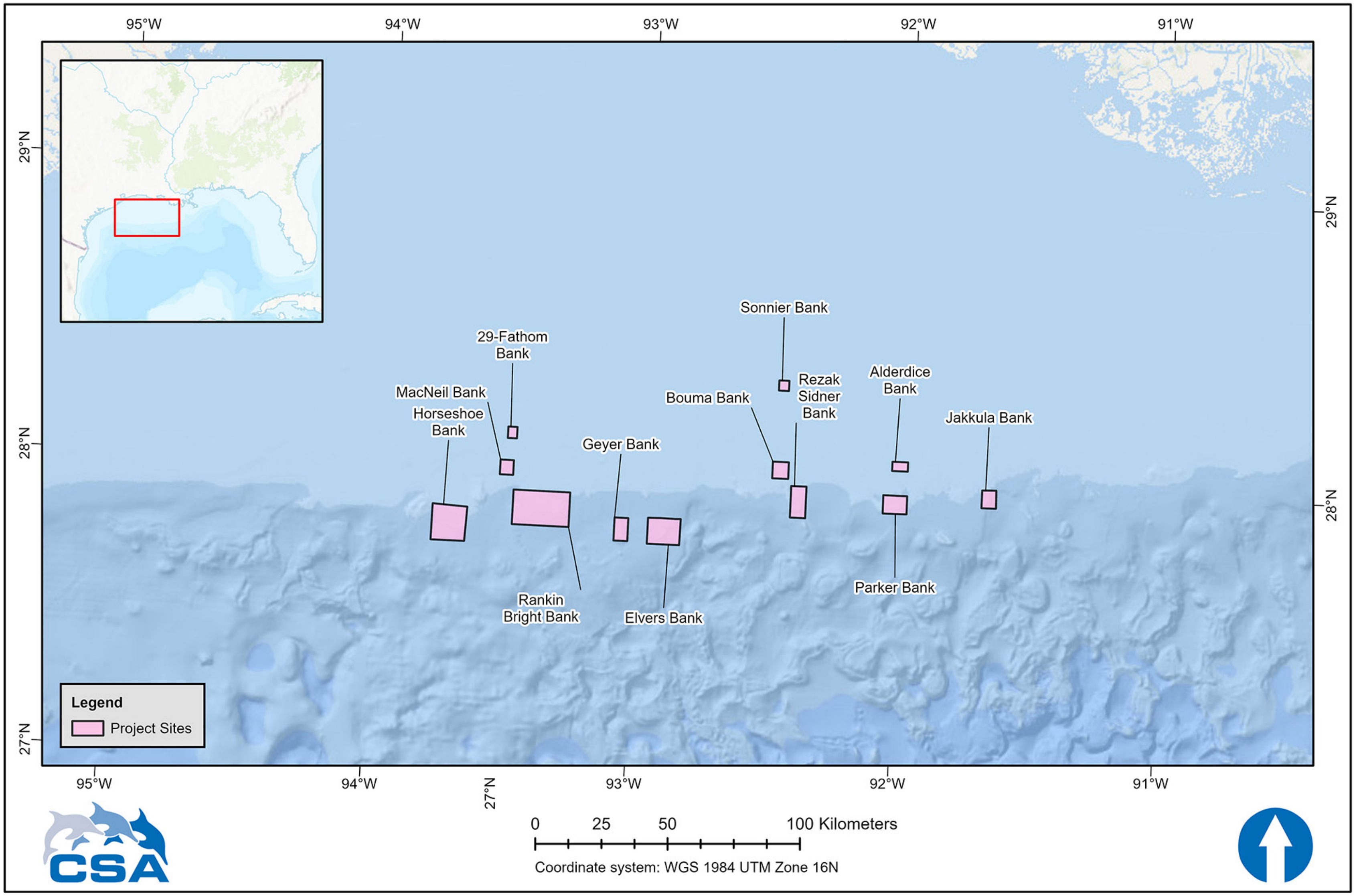

Figure 20. Northwestern GoM Region Project Sites selected for this analysis.

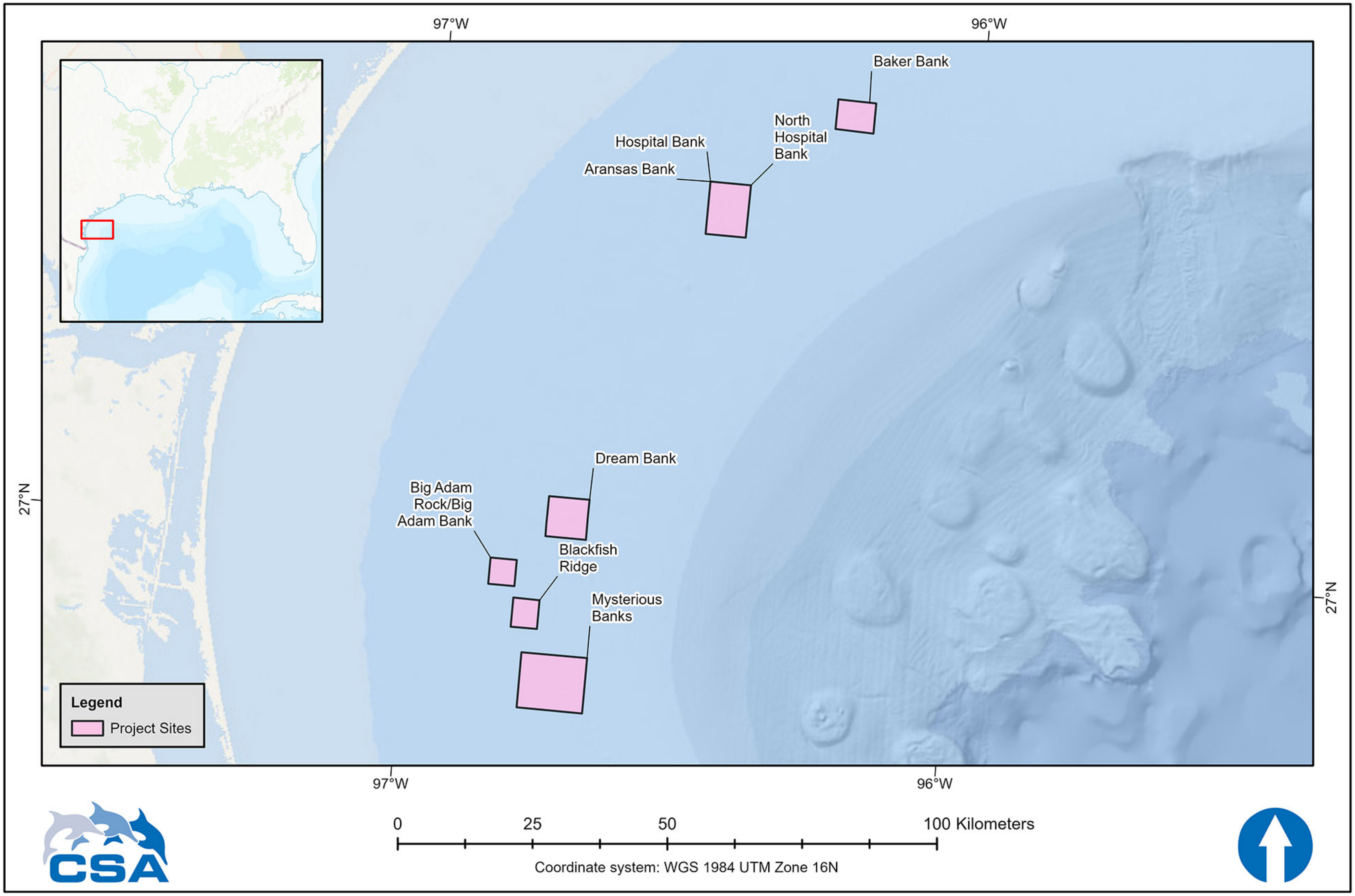

Figure 21. Southwestern GoM Region Project Sites selected for this analysis.

Some sites that were identified during the data search and review process (see S**ection 2.1.3.**) were added to the list of Project Sites (**Table 2**). The added sites were selected because they support ecologically important coral habitat that may benefit from management measures. Information on these sites were derived from previous studies conducted by CSA.

Note that many of the colloquial names used for sites above are not necessarily in common usage, may not appear in peer reviewed literature and may not be consistently used or recognized. Some of the names appear to have been applied by researchers for their particular projects or cruises, by geologists during hydrocarbon exploration, and by fishermen. Thus, in many cases where information was not identified for such smaller sites, it was necessary to default to the larger region, or megasite. For example, data were found related to the Northern West Florida Slope, but not identified explicitly to a specific colloquially named site (e.g., "Many Mounds") or other small research sites identified by scientists within that region.

3.1.2 Data Search and Review

A list of citations of articles, reports, etc. that were selected for each project site are presented in **Appendix A**. The complete database is provided as an EndNote Library as a separate electronic deliverable to the Council. A breakdown of citation types by project site and type are presented in **Table 3**.

Table 3. Breakdown of citation types by project site and type, including totals. Blank cells indicate no data available or located during the literature search task.

Project Site	Data Type					Total by Site
	Peer-Reviewed	Thesis or Dissertation	Agency Report	Miscellaneous Gray Literature	News Story	
Southeastern Gulf of Mexico						
Northern West Florida Slope	13	3	2	1		**19**
North Reed Site	1	1	1	1		**4**
Long Mound	1	1	2	1		**5**
Many Mounds	2	1	1	1		**5**
West Florida Wall	4	1	1		1	**7**
Southern West Florida Slope	13	3	2	1		**19**
Okeanos Ridge	1		2			**3**
Northeastern Gulf of Mexico						
Pinnacles Reefs	5		6			**11**
Triple Top Reef			2			**2**
Double Top Reef			2			**2**
Shark Reef			2			**2**
Far Tortuga			2			**2**
Patch Reef Field			2			**2**
Solitary Mound			2			**2**
Mountain Top Bank			2			**2**
Pinnacle 1 Near West			1	2		**3**
West Pinnacle 2			1	2		**3**
Porgy Reef			2			**2**
Cats Paw Reef			2			**2**
Yellowtail Reef	2	1	2			**5**

Table 3. (Continued).

Project Site	Data Type					Total by Site
	Peer-Reviewed	Thesis or Dissertation	Agency Report	Miscellaneous Gray Literature	News Story	
DeSoto Canyon						
DeSoto Canyon Rim	3	1	1	2		**7**
Destin Dome						
Destin Dome 51/52			1	1		**2**
Destin Dome 99; 55/56/57			1	1		**2**
Destin Dome 617				1		**1**
Northwestern Gulf of Mexico						
Sonnier Bank	3		2	1		**6**
29-Fathom Bank	2	2				**4**
MacNeil Bank	1			1		**2**
Alderdice Bank	4		6			**10**
Bouma Bank	2					**2**
Horseshoe Bank	2	1				**3**
Rankin Bright Bank	8	2	2			**12**
Geyer Bank	4	1	6			**11**
Elvers Bank	3	1	6			**10**
Rezak Sidner Bank	2	1	6			**9**
Parker Bank	2	1	2			**5**
Jakkula Bank	2		6			**8**
Southwestern Gulf of Mexico						
South Texas Banks - North						
Baker Bank	3	6	2			**11**
Hospital Bank	2	3	2			**7**
North Hospital Bank	2	4	2			**8**
Aransas Bank	3	6	2			**11**
South Texas Banks - South						
Dream Bank	2	5	1			**8**
Mysterious Banks	1	3	1			**5**
Big Adam Rock/Big Adam Bank	1	3	1			**5**
Blackfish Ridge	4	3	1			**8**
Total By Data Type	**98**	**54**	**88**	**16**	**1**	**-**

3.1.3 Data Compilation

The completed data compilation matrix is presented in **Appendix B, Table 1** (page 1 matrix). The distance/proximity analysis, which includes site center coordinates, referenced feature names (nearest river, disposal site, etc.) and coordinates of these features are presented in **Appendix B**, **Table 2** (page 2 matrix).

3.1.4 Ranking of Environmental Factors and Final Scoring

Following the criteria and scoring described in **Section 2.1.5**, all project sites received scores for relevant factors (**Table Z**). Total summed factor scores (**Table Z**) produced a hierarchy of relative site rankings, ranging from a high of 68 points (Rankin Bright Bank) to a low of 39 points (Pinnacle 1 Near West, West Pinnacle 2, 29-Fathom Bank). The seven deepest sites, which were on the West Florida Slope, exhibited consistently high values (51-62 points) and a relatively lower range of values. As might be expected the remaining sites exhibited more variability in total ranking points.

3.2 GEODATABASE

The draft geodatabase was provided as a separate electronic deliverable to the Council. The final deliverable will be submitted along with all other final deliverables after review.

3.3 WEB-BASED DASHBOARD

The draft web-based dashboard was provided as a separate electronic deliverable to the Council. The final deliverable will be submitted along with all other final deliverables after review.

4.0 Discussion

One of the most difficult tasks in resource management and perhaps even the most controversial, is the objective ecological assessment of marine ecosystems. Although challenging, such assessments are necessary and have proved useful in reef ecosystem evaluation to guide management actions (DeVantier et al. 1998; Ruttenberg et al. 2018). This area of environmental science is evolving with assessments being accomplished in a variety of ways, and there are few guidelines for standardizing such evaluations.

A large array of data were assembled and synthesized into a matrix that can be used to assess current status and future vulnerability of deep coral and hard-bottom sites in the GoM. The approach was robust yet uncomplicated, allowing for an informed, repeatable, and quasi-objective approach to site comparisons across the GoM. This data synthesis and ranking exercise is suggested as one means to view an array of data across a large geographic space. However, as noted several places in this report, the actual population of the data matrix as well as the data themselves can be improved (see above and Recommendations below).

5.0 Recommendations

1. An obvious aspect of constructing the matrix, was the amount of missing information. It is recommended that the Council evaluate the missing data and determine which data are most important to acquire. For example, based on perceived threats, certain sites may have a higher priority than others as targets for acquiring missing data.

2. The value of these site comparisons can be increased by adding additional sites. Even adding sites that are already well documented or protected will increase the range of data and facilitate a more accurate and robust assessment of GoM deep reef sites. Since many sites that were already well known and even already protected were omitted from this exercise, this excluded what could be considered the “best” deep reef sites. Without these sites included, we were left to evaluate a much smaller diversity of reefs. Ideally all deep-reef sites in the GoM should be included.

3. Related to number 1 above, detailed bathymetric mapping provides an array of data in addition to playing an important role in modelling exercises. It is recommended that acquiring, updating, or improving the multibeam sonar data should be undertaken with a priority being sites lacking such data.

4. Also related to number 1, the emphasis on and importance of deep-water corals throughout this process contrasted sharply with the lack of coral data and/or the variable quality of the data for many sites. Conducting targeted ROV or other remote visual surveys on sites with missing coral data is a cost-effective way to add important information.

5. The utility of many of the factors in the matrix might be improved by more detailed analysis. For example, examining the impacts of regional and local oceanography on a factor would likely yield a more accurate assessment of its impact. Such data may indicate that ocean currents are more important than simple distance from an impact source.

6.0 References

Clark R, Siceloff L, Winship A.2018. Mapping Bottom-contact Fishing Intensity in the Gulf of Mexico in Relation to Predicted Suitable Habitats for Deep Sea Corals. NOAA Technical Memorandum NOS NCCOS 242. Silver Spring, MD. 47 pp.

Coral Working Group, 2014. Coral Working Group Summary, Gulf Council Office, Tampa, FL, December 4th and 5th, 2014. IN: Final Amendment 9 to the Fishery Management Plan for the Coral and Coral Reefs of the Gulf of Mexico, U.S. Waters Including Final Environmental Impact Statement. Appendix A. pp. 54-59. https://gulfcouncil.org/wp-content/uploads/Final-Coral-9-DEIS-20181005_508C.pdf. Accessed 27 December 2021.

DeVantier LM, De'ath G, Done TJ Turak E.1998) Ec.logical assessment of a complex natural system: a case study from the Great Barrier Reef. Ecological Applications 8: 480-496.

Gulf of Mexico Fishery Management Council (GMFMC). 2018. Coral Habitat Areas Considered for Habitat Area of Particular Concern Designation in the Gulf of Mexico. Final Amendment 9 to the Fishery Management Plan for the Coral and Coral Reefs of the Gulf of Mexico, U.S. Waters, Including Final Environmental Impact Statement - November 2018. https://gulfcouncil.org/wp-content/uploads/Final-Coral-9-DEIS-20181005_508C.pdf .

Gulf of Mexico Fishery Management Council (GMFMC). 2019. Commercial Fishing Regulations for Gulf of Mexico Federal Waters for Species Managed by the Gulf of Mexico Fishery Management Council, January 2019. https://gulfcouncil.org/wp-content/uploads/commercial-regulations.pdf.

Joint Coral Scientific and Statistical Committee and Coral Advisory Panel. 2015. Panel Summary (May 27, 2015). https://gulfcouncil.org/wp-content/uploads/Coral-AP_SSC-summary-May-2015.pdf. Accessed 27 December 2021.

Marinecadastre.gov, 2021. So What? Habitat Areas of Particular Concern. https://www.marinecadastre.gov/SiteCollectionDocuments/SoWhat_HAPCs_final_template.pdf Accessed 9 November 2021.

McLeod E, Salm R, Green A, Almany J. 2009. Designing marine protected area networks to address the impacts of climate change. Frontiers in Ecology and the Environment 7(7): 362-370.

Moffitt EA, White JW, Botsford LW. 2011. The utility and limitations of size and spacing guidelines for designing marine protected area (MPA) networks. Biological Conservation 144: 306-318.

NOAA Fisheries. 2021. Essential Fish Habitat. https://www.fisheries.noaa.gov/national/habitat-conservation/essential-fish-habitat. Accessed on 2 December 2021.

NOAA Fisheries. 2022. Magnuson-Stevens Fishery Conservation and Management Act – 2007. https://www.fisheries.noaa.gov/resource/document/magnuson-stevens-fishery-conservation-and-management-act. Accessed on 24 January 2022.

Ross SW, Quattrini AM. 2007. The fish fauna associated with deep coral banks off the Southeastern United States. Deep Sea Research. Part I: Oceanographic Research Papers 54(6): 975-1007.

Ross SW, Rhode M, Quattrini AM. 2015. Demersal fish distribution and habitat use within and near Baltimore and Norfolk Canyons, U.S. middle Atlantic slope. Deep-Sea Research. Part I: Oceanographic Research Papers 103: 137-154.

Ruttenberg B, Caselle JE, Estep AJ, Johnson AE, Marhaver KL, Richter LJ, et al. 2018. Ecological assessment of the marine ecosystems of Barbuda, West Indies: Using rapid scientific assessment to inform ocean zoning and fisheries management. PLoS ONE 13(1): e0189355. https://doi.org/10.1371/journal.pone.0189355. Accessed 27 December 2021.

U.S. Dept. of the Interior, Bureau of Ocean Energy Management (BOEM). 2021. BOEM GOM Renewable Energy Update. https://gulfcouncil.org/wp-content/uploads/X.-GOM-Renewables-Shrimp-Advisory-Panel.pdf. Accessed on 24 January 2022.

Vandeperre F, et al. [24 co-authors). 2011. Effects of no-take area size and age of marine protected areas on fisheries yields: a meta-analytical approach. Fish and Fisheries 12(4): 412-426.

Appendices

Appendix A:
List of Data Search Citations by Project Site

GENERAL (NOT SITE SPECIFIC)

Andrews JE, Bainbridge C. 1972. Submarine canyons off eastern Oahu. Pacific Science 26: 108-113. (Peer reviewed).

Bloomberg J, Holstein DM. 2021. Mesophotic coral refuges following multiple disturbances. Coral Reefs 40(3): 821-834. (Peer reviewed).

Boland GS. 2022. Chapter 8 - Deep-water study partnerships: characterizing and understanding the ecological role of deep corals and chemosynthetic communities in the Gulf of Mexico and northwest Atlantic. In: Auad G, Wiese FK (Eds.), Partnerships in Marine Research. Elsevier. pp. 131-154. (Peer reviewed).

Bracco A, Paris CB, Esbaugh AJ, Frasier K, Joye SB, Liu G, Polzin KL, Vaz AC. 2020. Transport, Fate and Impacts of the Deep Plume of Petroleum Hydrocarbons Formed During the Macondo Blowout. Frontiers in Marine Science 7: Article 542147. (Peer reviewed).

Brooke SD, Holmes MW, Young CM. 2009. Sediment tolerance of two different morphotypes of the deep-sea coral Lophelia pertusa from the Gulf of Mexico. Marine Ecology Progress Series 390: 137-144. (Peer reviewed).

Clark RL, Siceloff L, Winship A. 2018. Mapping bottom-contact fishing intensity in the Gulf of Mexico in relation to predicted suitable habitats for deep sea corals. NOAA Technical Memorandum NOS NCCOS 242. 47 pp. (Agency Report)

Cleland J, Kazanidis G, Roberts JM, Ross SW. 2021. Distribution of Megabenthic Communities Under Contrasting Settings in Deep-Sea Cold Seeps Near Northwest Atlantic Canyons. Frontiers in Marine Science 8. (Peer reviewed).

Creed JC, Fenner D, Sammarco P, Cairns S, Capel K, Junqueira AOR, Cruz I, Miranda RJ, Carlos-Junior L, Mantelatto MC, Oigman-Pszczol S. 2017. The invasion of the azooxanthellate coral Tubastraea (Scleractinia: Dendrophylliidae) throughout the world: history, pathways and vectors. Biological Invasions 19(1): 283-305. (Peer reviewed).

DeLeo DM, Glazier A, Herrera S, Barkman A, Cordes EE. 2021. Transcriptomic Responses of Deep-Sea Corals Experimentally Exposed to Crude Oil and Dispersant. Frontiers in Marine Science 8: Article 649909. (Peer reviewed).

DeLeo FC, Vetter EW, Smith CR, Rowden AA, McGranaghan M. 2014. Spatial scale-dependent habitat heterogeneity influences submarine canyon macrofaunal abundance and diversity off the Main and Northwest Hawaiian Islands. Deep Sea Research Part II: Topical Studies in Oceanography 104: 267-290. (Peer reviewed).

Drexler M. 2018. Evaluating the Use of Larval Connectivity Information in Fisheries Models and Management in the Gulf of Mexico. Ph.D. dissertation, University of South Florida. 127 pp. Thesis/Dissertation).

Etnoyer PJ, Wickes LN, Silva M, Dubick JD, Balthis L, Salgado E, MacDonald IR. 2016. Decline in condition of gorgonian octocorals on mesophotic reefs in the northern Gulf of Mexico: before and after the Deepwater Horizon oil spill. Coral Reefs 35(1): 77-90. (Peer reviewed).

Etnoyer PJ, Wagner D, Fowle HA, Poti M, Kinlan B, Georgian SE, Cordes EE. 2018. Models of habitat suitability, size, and age-class structure for the deep-sea black coral *Leiopathes glaberrima* in the Gulf of Mexico. Deep Sea Research Part II: Topical Studies in Oceanography 150: 218-228. (Peer reviewed).

Figueroa DF, McClure A, Figueroa NJ, Hicks DW. 2019. Hiding in plain sight: invasive coral *Tubastraea tagusensis* (Scleractinia:Hexacorallia) in the Gulf of Mexico. Coral Reefs 38(3): 395-403. (Peer reviewed).

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral Reefs in the Gulf of Mexico Large Marine Ecosystem: Conservation Status, Challenges, and Opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

Hall ER, Wickes L, Burnett LE, Scott GI, Hernandez D, Yates KK, Barbero L, Reimer JJ, Baalousha M, Mintz J, Cai WJ, Craig JK, DeVoe MR, Fisher WS, Hathaway TK, Jewett EB, Johnson Z, Keener P, Mordecai RS, Noakes S, Phillips C, Sandifer PA, Schnetzer A, Styron J. 2020. Acidification in the U.S. Southeast: Causes, Potential Consequences and the Role of the Southeast Ocean and Coastal Acidification Network. Frontiiers in Marine Science 7: Article 548. (Peer reviewed).

Hinderstein LM, Marr JCA, Martinez FA, Dowgiallo MJ, Puglise KA, Pyle RL, Zawada DG, Appeldoorn R. 2010. Theme section on "Mesophotic Coral Ecosystems: Characterization, Ecology, and Management". Coral Reefs 29(2): 247-251. (Peer reviewed).

Hoffmayer ER, Franks JS, Driggers WB, McKinney JA, Hendon JM, Quattro JM. 2014. Habitat, movements and environmental preferences of dusky sharks, Carcharhinus obscurus, in the northern Gulf of Mexico. Marine Biology 161(4): 911-924. (Peer reviewed).

Hu Z, Hu J, Hu H, Zhou Y. 2020. Predictive habitat suitability modeling of deep-sea framework-forming scleractinian corals in the Gulf of Mexico. Science of the Total Environment 742: 140562. (Peer reviewed).

Jiang M, Pan C, Barbero L, Reed J, Salisbury JE, VanZwieten JH, Wanninkhof R. 2020. Variability of bottom carbonate chemistry over the deep coral reefs in the Florida Straits and the impacts of mesoscale processes. Ocean Modelling 147: 101555. (Peer reviewed).

Johnston MW, Bernard AM. 2016. A bank divided: quantifying a spatial and temporal connectivity break between the Campeche Bank and the northeastern Gulf of Mexico. Marine Biology 164(1): Article 12. (Peer reviewed).

Jones ES, Ross SW, Robertson CM, Young CM. 2022. Distributions of microplastics and larger anthropogenic debris in Norfolk Canyon, Baltimore Canyon, and the adjacent continental slope (Western North Atlantic Margin, U.S.A.). Marine Pollution Bulletin 174: 113047. (Peer reviewed).

Kahng SE, Garcia-Sais JR, Spalding HL, Brokovich E, Wagner D, Weil E, Hinderstein L, Toonen RJ. 2010. Community ecology of mesophotic coral reef ecosystems. Coral Reefs 29(2): 255-275. (Peer reviewed).

Le Hénaff M, Kourafalou VH. 2016. Mississippi waters reaching South Florida reefs under no flood conditions: synthesis of observing and modeling system findings. Ocean Dynamics 66(3): 435-459. (Peer reviewed).

Lim A, Wheeler AJ, Conti L. 2020. Cold-Water Coral Habitat Mapping: Trends and Developments in Acquisition and Processing Methods. Geosciences 11: Article 9. (Peer reviewed).

Locker SD, Armstrong RA, Battista TA, Rooney JJ, Sherman C, Zawada DG. 2010. Geomorphology of mesophotic coral ecosystems: current perspectives on morphology, distribution, and mapping strategies. Coral Reefs 29(2): 329-345. (Peer reviewed).

Mathewson CC. 1970. Submarine canyons and the shelf along the north coast of Molokai Island, Hawaiian Ridge. Pacific Science 24: 235-244. (Peer reviewed).

Nuttall MF, Hickerson EL, Blakeway RD, Schmahl GP, Sammarco PW. 2022. Do Oil and Gas Lease Stipulations in the Northwestern Gulf of Mexico Need Expansion to Better Protect Vulnerable Coral Communities? How Low Relief Habitats Support High Coral Biodiversity. Frontiers in Marine Science 8: 780248. (Peer reviewed).

Pavliska CL. 2019. DNA Barcoding Reveals Unexpected Diversity in Octocorallia in the Northwest Gulf of Mexico. M.S. Thesis, University of Texas Rio Grande Valley. 76 pp. (Thesis/Dissertation)

Pinheiro HT, Eyal G, Shepherd B, Rocha LA. 2019. Ecological insights from environmental disturbances in mesophotic coral ecosystems. Ecosphere 10(4): e02666. (Peer reviewed).

Precht WF, Hickerson EL, Schmahl GP, Aronson RB. 2014. The Invasive Coral Tubastraea coccinea (Lesson, 1829): Implications for Natural Habitats in the Gulf of Mexico and the Florida Keys. Gulf of Mexico Science 32(1): Article 5. (Peer reviewed).

Quattrini AM, Etnoyer PJ, Doughty C, English L, Falco R, Remon N, Rittinghouse M, Cordes EE. 2014. A phylogenetic approach to octocoral community structure in the deep Gulf of Mexico. Deep Sea Research Part II: Topical Studies in Oceanography 99: 92-102. (Peer reviewed).

Quattrini AM, Gomez CE, Cordes EE. 2017. Environmental filtering and neutral processes shape octocoral community assembly in the deep sea. Oecologia 183(1): 221-236. (Peer reviewed).

Quattrini AM. 2014. Genetic Connectivity of Octocorallia Across Abiotic Gradients in the Deep Gulf of Mexico. Ph.D. dissertation. Temple University. 197 pp. (Thesis/Dissertation)

Robertson DR, Dominguez-Dominguez O, Victor B, Simoes N. 2018. An Indo-Pacific damselfish (Neopomacentrus cyanomos) in the Gulf of Mexico: origin and mode of introduction. PeerJ 6: e4328. (Peer reviewed).

Sagarese SR, Gruss A, Karnauskas M, Walter JFI. 2014. Ontogenetic Spatial Distributions of Red Grouper (Epinephelus Morio) within the Northeastern Gulf of Mexico and Spatio-Temporal Overlap with Red Tide Events. SEDAR42-DW-04. 32 pp. (Miscellaneous gray literature).

Sammarco PW, Atchison AD, Boland GS, Sinclair J, Lirette A. 2012. Geographic expansion of hermatypic and ahermatypic corals in the Gulf of Mexico, and implications for dispersal and recruitment. Journal of Experimental Marine Biology and Ecology 436-437: 36-49. (Peer reviewed).

Sammarco PW, Porter SA, Sinclair J, Genazzio M. 2014. Population expansion of a new invasive coral species, Tubastraea micranthus, in the northern Gulf of Mexico. Marine Ecology Progress Series 495: 161-173. (Peer reviewed).

Schulze A, Erdner DL, Grimes CJ, Holstein DM, Miglietta MP. 2020. Artificial Reefs in the Northern Gulf of Mexico: Community Ecology Amid the "Ocean Sprawl". Frontiers in Marine Science 7: Article 447. (Peer reviewed).

Semmler RF, Hoot WC, Reaka ML. 2016. Are mesophotic coral ecosystems distinct communities and can they serve as refugia for shallow reefs? Coral Reefs 36(2): 433-444. (Peer reviewed).

U.S. Geological Survey. 2022a. Specimen observation data for Neopomacentrus cyanomos (Bleeker, 1856), Nonindigenous Aquatic Species Database. Website accessed 1/30/22. https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=2936 (Agency Report)

U.S. Geological Survey. 2022b. Lionfish: Specimen observation data for Pterois volitans/miles, Nonindigenous Aquatic Species Database. Website accessed 1/30/2022. https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=963 (Agency Report)

Velez S. 2018. Juvenile Population Dynamics of Families Lutjanidae and Serranidae in the Gulf of Mexico, with Respect to the Loop Current and other Hydrographic Features. M.S. Thesis, Florida Atlantic University. 139 pp. (Thesis/Dissertation).

Vetter EW, Smith CR, De Leo FC. 2010. Hawaiian hotspots: enhanced megafaunal abundance and diversity in submarine canyons on the oceanic islands of Hawaii. Marine Ecology 31(1): 183-199. (Peer reviewed).

SOUTHEASTERN GoM

WEST FLORIDA SLOPE

Brooks, G.R. and C.W. Holmes. 2011. West Florida Continental Slope. p. 129-139. In: Buster, N.A. and C.W. Holmes (eds.). Gulf of Mexico: Origin, Waters, and Biota. Vol. 3. Geology. Texas A&M Univ. Press.

Christeson GL, Van Avendonk HJA, Norton IO, Snedden JW, Eddy DR, Karner GD, Johnson CA. 2014. Deep crustal structure in the eastern Gulf of Mexico. Journal of Geophysical Research: Solid Earth 119(9): 6782-6801. (Peer reviewed).

Demopoulos, A.W.J., S.W. Ross, C.A. Kellogg, C.L. Morrison, M. Nizinski, N.G. Prouty, J.R. Bourque, J.P. Galkiewicz, M.A. Gray, M.J. Springmann, D.K. Coykendall, A. Miller, M. Rhode, A. Quattrini, C.L. Ames, S. Brooke, J. McClain-Counts, E.B. Roark, N.A. Buster, R.M. Philips and J. Frometa. 2017. Deepwater Program: Lophelia II, Continuing Ecological Research on Deep-Sea Corals and Deep Reef Habitats in the Gulf of Mexico. U.S. Dept. of the Interior, U.S. Geol. Surv., Open-File Rept. 2017–1139, 269 p.

Dupont JM. 2009. Ecological Dynamics of Livebottom Ledges and Artificial Reefs on the Inner Central West Florida Shelf. Ph.D. dissertation, University of South Florida. 164 pp. (Thesis/Dissertation).

Etnoyer PJ, Wickes LN, Silva M, Dubick JD, Balthis L, Salgado E, MacDonald IR. 2016. Decline in condition of gorgonian octocorals on mesophotic reefs in the northern Gulf of Mexico: before and after the Deepwater Horizon oil spill. Coral Reefs 35(1): 77-90. (Peer reviewed).

Etnoyer PJ, Wagner D, Fowle HA, Poti M, Kinlan B, Georgian SE, Cordes EE. 2018. Models of habitat suitability, size, and age-class structure for the deep-sea black coral *Leiopathes glaberrima* in the Gulf of Mexico. Deep Sea Research Part II: Topical Studies in Oceanography 150: 218-228. (Peer reviewed).

.Gittings SR, Bright TJ, Schroeder WW, Sager WW, Laswell SJ, Rezak R. 1992. Invertebrate assemblages and ecological controls on topographic features in the Northeast Gulf of Mexico. Bulletin of Marine Science 50(3): 435-455. (Peer reviewed).

Hu Z, Hu J, Hu H, Zhou Y. 2020. Predictive habitat suitability modeling of deep-sea framework-forming scleractinian corals in the Gulf of Mexico. Science of the Total Environment 742: Article 140562. (Peer reviewed).

Hübscher C, Dullo C, Flögel S, Titschack J, Schönfeld J. 2010. Contourite drift evolution and related coral growth in the eastern Gulf of Mexico and its gateways. International Journal of Earth Sciences 99(S1): 191-206. (Peer reviewed).

Lunden JJ, McNicholl CG, Sears CR, Morrison CL, Cordes EE. 2014. Acute survivorship of the deep-sea coral *Lophelia pertusa* from the Gulf of Mexico under acidification, warming, and deoxygenation. Frontiers in Marine Science 1: Article 78. (Peer reviewed).

Macelloni L, Lutken CB, Ingrassia M, D' Emidio M, Pizzi M. 2016. Mesoscale biogeophysical characterization of Woolsey Mound (northern Gulf of Mexico), a new attribute of natural marine hydrocarbon seeps architecture. Marine Geology 380: 330-344. (Peer reviewed).

Meeder JF. 1987. The Paleoecology, Petrology and Depositional Model of the Pliocene Tamiami Formation, Southwest Florida (With Special Reference to Corals and Reef Development). Ph.D. dissertation, University of Miami. 748 pp. (Thesis/Dissertation).

Morrison CL, Ross SW, Nizinski MS, Brooke S, Järnegren J, Waller RG, Johnson RL, King TL. 2011. Genetic discontinuity among regional populations of *Lophelia pertusa* in the North Atlantic Ocean. Conservation Genetics 12(3): 713-729. (Peer reviewed).

Newton CR, Mullins HT, Gardulski AF, Hine AC, Dix GR. 1987. Coral mounds on the West Florida Slope: Unanswered questions regarding the development of deep-water banks. Palaios 2: 359-367. (Peer reviewed).

Newton CR, Mullins HT, Gardulski AF, Hine AC, Dix GR. 1987. Coral mounds on the West Florida Slope: Unanswered questions regarding the development of deep-water banks. Palaios 2: 359-367. (Peer reviewed).

Nguyen TT. 2014. Variability of Cross-slope Flow in the DeSoto Canyon Region. M.S. Thesis. Florida State University. 70 pp. (Thesis/Dissertation).

Proux ZS. 2018. Assessing the Relationship between Geomorphology and Deep-sea Megafaunal Communities on the West Coast Escarpment. M.S. Thesis, University of Charleston. 47 pp. (Thesis/Dissertation).

Quattrini AM, Etnoyer PJ, Doughty C, English L, Falco R, Remon N, Rittinghouse M, Cordes EE. 2014. A phylogenetic approach to octocoral community structure in the deep Gulf of Mexico. Deep Sea Research Part II: Topical Studies in Oceanography 99: 92-102. (Peer reviewed).

Quattrini AM, Gomez CE, Cordes EE. 2017. Environmental filtering and neutral processes shape octocoral community assembly in the deep sea. Oecologia 183(1): 221-236. (Peer reviewed).

Quattrini AM. 2014. Genetic Connectivity of Octocorallia Across Abiotic Gradients in the Deep Gulf of Mexico. Ph.D. dissertation, Temple University. 197 pp. (Thesis/Dissertation).

Reed JK, Weaver DC, Pomponi SA. 2006. Habitat and fauna of deep-water *Lophelia pertusa* coral reefs off the southeastern U.S.: Blake plateau, Straits of Florida, and Gulf of Mexico. Bulletin of Marine Science 78(2): 343-375. (Peer reviewed).

Ross SW, Rhode M, Brooke S. 2017. Deep-sea coral and hardbottom habitats on the west Florida slope, eastern Gulf of Mexico. Deep Sea Research Part I: Oceanographic Research Papers 120: 14-28. (Peer reviewed).

Ruiz-Ramos DV, Saunders M, Fisher CR, Baums IB. 2015. Home bodies and wanderers: sympatric lineages of the deep-sea black coral *Leiopathes glaberrima*. PLoS One 10(10): e0138989. (Peer reviewed).

Ruiz-Ramos DV. 2014. Molecular Investigations of Deep-sea Black Coral Ecology. Ph.D. dissertation. Pennsylvania State University. 181 pp. (Thesis/Dissertation).

Schroeder WW. 2002. Observations of *Lophelia pertusa* and the surficial geology at a deep-water site in the northeastern Gulf of Mexico. Hydrobiologia 471(1): 29-33. (Peer reviewed).

Wagner D, Kilgour M, Etnoyer PJ. 2018. Expedition Report: 2017 Southeast Deep Coral Initiative (SEDCI) expedition aboard NOAA Ship Nancy Foster (NF-17-08: August 12-31, 2017). NOAA Technical Memorandum NOS NCCOS 244. 125 pp. (Agency Report.

Wall KR. 2017. Subtropical Benthos Vary with Reef Type, Depth and Grazing Intensity. M.S. Thesis, University of South Florida. 66 pp. (Thesis/Dissertation).

LONG MOUND

Proux ZS. 2018. Assessing the Relationship between Geomorphology and Deep-sea Megafaunal Communities on the West Coast Escarpment. M.S. Thesis, University of Charleston. 47 pp. (Thesis/Dissertation).

Simões Corrêa TB. 2012. Environmental Controls on Cold-Water Mound Distribution, Morphology, and Development in the Straits of Florida. Ph.D. dissertation, University of Miami. 195 pp. (Thesis/Dissertation).

Wagner D, Kilgour M, Etnoyer PJ. 2018. Expedition Report: 2017 Southeast Deep Coral Initiative (SEDCI) expedition aboard NOAA Ship Nancy Foster (NF-17-08: August 12-31, 2017). NOAA Technical Memorandum NOS NCCOS 244. 125 pp. (Agency Report).

MANY MOUNDS

Proux ZS. 2018. Assessing the Relationship between Geomorphology and Deep-sea Megafaunal Communities on the West Coast Escarpment. M.S. Thesis, University of Charleston. 47 pp. (Thesis/Dissertation).

Simões Corrêa TB. 2012. Environmental Controls on Cold-Water Mound Distribution, Morphology, and Development in the Straits of Florida. Ph.D. dissertation, University of Miami. 195 pp. (Thesis/Dissertation).

Wagner D, Kilgour M, Etnoyer PJ. 2018. Expedition Report: 2017 Southeast Deep Coral Initiative (SEDCI) expedition aboard NOAA Ship Nancy Foster (NF-17-08: August 12-31, 2017). NOAA Technical Memorandum NOS NCCOS 244. 125 pp. (Agency Report).

NORTH REED

Bracco A, Paris CB, Esbaugh AJ, Frasier K, Joye SB, Liu G, Polzin KL, Vaz AC. 2020. Transport, Fate and impacts of the deep plume of petroleum hydrocarbons formed during the Macondo blowout. Frontiers in Marine Science 7: Article 542147. (Peer reviewed).

Ji C, Beegle-Krause CJ, Englehardt JD. 2020. Formation, detection, and modeling of submerged oil: a review. Journal of Marine Science and Engineering 8(9): 642. (Peer reviewed).

Proux ZS. 2018. Assessing the Relationship between Geomorphology and Deep-sea Megafaunal Communities on the West Coast Escarpment. M.S. Thesis, University of Charleston. 47 pp. (Thesis/Dissertation).

Wagner D, Kilgour M, Etnoyer PJ. 2018. Expedition Report: 2017 Southeast Deep Coral Initiative (SEDCI) expedition aboard NOAA Ship Nancy Foster (NF-17-08: August 12-31, 2017). NOAA Technical Memorandum NOS NCCOS 244. 125 pp. (Agency Report).

OKEANOS RIDGE

Kellogg CA, Pratte ZA. 2021. Unexpected diversity of Endozoicomonas in deep-sea corals. Marine Ecology Progress Series 673: 1-15. (Peer reviewed).

Proux ZS. 2018. Assessing the Relationship between Geomorphology and Deep-sea Megafaunal Communities on the West Coast Escarpment. M.S. Thesis, University of Charleston. 47 pp. (Thesis/Dissertation).

Salgado EJ, Entnoyer PJ. Photographic Catalog of Deep-Sea Corals Collected from the US West Atlantic Margin by NOAA Ship Okeanos Explorer in Years 2017- 2019. NOAA Technical Memorandum NOS NCCOS 273. 129 pp. (Agency Report).

Vohsen SA, Gruber-Vodicka HR, Osman EO, Saxton MA, Joye SB, Dubilier N, Fisher CR, Baums IB. 2020. Deep-sea corals near cold seeps associate with chemoautotrophic bacteria that are related to the symbionts of cold seep and hydrothermal vent mussels. Microbiome 8(1): 1-15. (Peer reviewed).

Wagner D, Kilgour M, Etnoyer PJ. 2018. Expedition Report: 2017 Southeast Deep Coral Initiative (SEDCI) expedition aboard NOAA Ship Nancy Foster (NF-17-08: August 12-31, 2017). NOAA Technical Memorandum NOS NCCOS 244. 125 pp. (Agency Report).

White MP, Kennedy BRC, Amon D, Messing CA, A.M. 2020. Cruise Report: EX-17-11, Gulf of Mexico 2017 (ROV and Mapping). Silver Spring, MD: Office of Ocean Exploration and Research, Office of Oceanic and Atmospheric Research, NOAA OER Expedition Report 17-11. 89 pp. (Agency Report).

NORTHEASTERN GoM

PATCH REEF FIELD

Ruhl EJ. 2018. Understanding the Importance of Habitat Complexity for Juvenile Fish and the Application of 3d Printed Corals for Reef Restoration. M.S. Thesis, University of Delaware. 92 pp. (Thesis/Dissertation).

PINNACLES REEFS (VARIOUS)

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama Pinnacle Trend Ecosystem Monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 1998. Northeastern Gulf of Mexico Coastal and Marine Ecosystem Program: Ecosystem Monitoring, Mississippi/Alabama Shelf; Second Annual Interim Report. OCS Study MMS 98-0044; USGS/BRDICR-1998-0002. 198 pp. + apps. (Agency Report).

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 1997. Northeastern Gulf of Mexico Coastal and Marine Ecosystem Program: Ecosystem Monitoring, Mississippi/Alabama Shelf; First Annual Interim Report. OCS Study MMS 97-0037; USGS/BRD/CR-1997-0008. 133 pp. + apps. (Agency Report).

Continental Shelf Associates Inc. 1996. Photodocumentation Surveys of Destin Dome Area Blocks 12, 13, 14, 15, 16, 54, 55, 56, 57, 99, and 100. Jupiter, FL: Continental Shelf Associates Inc. 81 pp. + apps. (Miscellaneous gray literature).

Continental Shelf Associates Inc. 1992. Photodocumentation Survey of Proposed Rainbow Gathering System Pipeline Route from Mobile Bay Area Block 916 to Destin Dome Area Block 56. Jupiter, FL: Continental Shelf Associates Inc. 27 pp. + apps. (Miscellaneous gray literature).

Continental Shelf Associates Inc. 1985. Live-Bottom Survey of Drillsite Locations in Destin Dome Area, Block 617. Jupiter, FL: Continental Shelf Associates Inc. 39 + apps. (Miscellaneous gray literature).

Continental Shelf Associates Inc. 1991. Photodocumentation Survey of Destin Dome Area Blocks 51 and 52. Jupiter, FL: Continental Shelf Associates Inc. 32 pp. + apps. (Miscellaneous gray literature).

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 1999. Northeastern Gulf of Mexico Coastal and Marine Ecosystem Program: Ecosystem Monitoring, Mississippi/Alabama Shelf; Third Annual Interim Report. Jupiter, FL: Continental Shelf Associates Inc. OCS Study MMS 99-0055. 211 pp. (Agency Report).

TRIPLE TOP REEF

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

DOUBLE TOP REEF

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

SHARK REEF

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

FAR TORTUGA

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

SOLITARY MOUND

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

MOUNTAIN TOP BANK

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

PINNACLE 1 NEAR WEST

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

PORGY REEF

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

CATS PAW REEF

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

YELLOWTAIL REEF

Continental Shelf Associates Inc., Texas A & M University. Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring, Final Synthesis Report. OCS Study MMS 2001-080. 415 pp. + apps. (Agency Report).

Etnoyer PJ, Wickes LN, Silva M, Dubick JD, Balthis L, Salgado E, MacDonald IR. 2016. Decline in condition of gorgonian octocorals on mesophotic reefs in the northern Gulf of Mexico: before and after the Deepwater Horizon oil spill. Coral Reefs 35(1): 77-90. (Peer reviewed).

Silva M, Etnoyer PJ, MacDonald IR. 2016. Coral injuries observed at Mesophotic Reefs after the Deepwater Horizon oil discharge. Deep Sea Research Part II: Topical Studies in Oceanography 129: 96-107. (Peer reviewed).

Silva-Aguilera M. 2017. Fate of the Mesophotic Coral Ecosystem (Mce) in the Northeastern Gulf of Mexico after the Deepwater Horizon Incident: Impacts, Restoration, Conservation, and Hazards. Ph.D. dissertation. Florida State University. 119 pp. (Thesis/Dissertation).

Weaver DC, Dennis GD, Sulak KJ. 2002. Community Structure and Trophic Ecology of Fishes on the Pinnacles Reef Tract. OCS Study MMS 2002-034. 94 + apps. (Agency Report).

DESOTO CANYON RIM

Thompson et al., 1999. Ecology of Live Bottom Habitats of the NW GoM: A Community Profile USDOI, USGHS, USGS/BRD/CR – 1999-0001.

CSA. 1992. Photodocumentation survey of proposed Rainbow gathering system pipeline route from Mobile Bay Area Block 916 to Destin Dome Area Block 56. Report prepared for Chevron U.S.A., Inc.

DESTIN DOME 51/52

CSA. 1991. Photodocumentation survey of Destin Dome Area Blocks 51 and 52. Report prepared for Mobil Exploration and Producing U.S. Inc.

DESTIN DOME 99; 55/56/57

CSA. 1996. Photodocumentation surveys of Destin Dome Area Blocks 12, 13, 14, 15, 16, 54, 55, 56, 57, 99, and 100. Report prepared for Chevron U.S.A. Inc.

DESTIN DOME 617

CSA. 1985. Live bottom survey of drill site locations in Destin Dome Area Block 617. Report prepared for Chevron U.S.A. Inc.

NORTHWESTERN GoM

29 FATHOM BANK

Giammona CPJ. 1978. Octocorals in the Gulf of Mexico - Their Taxonomy and Distribution with Remarks on their Paleontology. Ph.D. dissertation, Texas A & M University. 260 pp. (Thesis/Dissertation).

Nash HL. 2013. Trinational Governance to Protect Ecological Connectivity: Support for Establishing an International Gulf of Mexico Marine Protected Area Network. Ph.D. dissertation, Texas A & M University - Corpus Christi. 218 pp. (Thesis/Dissertation).

Nash HL, McLaughlin RJ. 2014. A policy approach to establish an international network of marine protected areas in the Gulf of Mexico region. Australian Journal of Maritime & Ocean Affairs 6(3): 119-153. (Peer reviewed).

Sammarco PW, Nuttall MF, Beltz D, Hickerson EL, Schmahl GP. 2016. Patterns of mesophotic benthic community structure on banks off vs inside the continental shelf edge, Gulf of Mexico. Gulf of Mexico Science 33(1): 77-92. (Peer reviewed).

ALDERDICE BANK

Frometa J, Etnoyer PJ, Quattrini AM, Herrera S, Greig TW. 2021. Genetic divergence and polyphyly in the octocoral genus *Swiftia* [Cnidaria: Octocorallia], including a species impacted by the DWH oil spill. Diversity 13(4): Article 172. (Peer reviewed).

Hoffmayer ER, Franks JS, Driggers WB, McKinney JA, Hendon JM, Quattro JM. 2014. Habitat, movements and environmental preferences of dusky sharks, *Carcharhinus obscurus*, in the northern Gulf of Mexico. Marine Biology 161(4): 911-924. (Peer reviewed).

Nuttall MF, Hickerson EL, Blakeway RD, Schmahl GP and Sammarco PW. 2022. Do Oil and Gas Lease Stipulations in the Northwestern Gulf of Mexico Need Expansion to Better Protect Vulnerable Coral Communities? How Low Relief Habitats Support High Coral Biodiversity. Front. Mar. Sci. 8:780248. doi: 10.3389/fmars.2021.780248.

BOUMA BANK

Campbell MD, Rademacher KR, Noble B, Salisbury J, Felts P, Moser J, Caillouet R, Hendon M, Driggers WB. 2019. Status and trends of Marbled Grouper in the North-Central Gulf of Mexico. Marine and Coastal Fisheries 11(2): 114-124. (Peer reviewed).

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

Sammarco PW, Nuttall MF, Beltz D, Hickerson EL, Schmahl GP. 2016. Patterns of mesophotic benthic community structure on banks off vs inside the continental shelf edge, Gulf of Mexico. Gulf of Mexico Science 33(1): 77-92. (Peer reviewed).

Tolan JM. 2001. Patterns of Reef-Fish Larval Supply to Petroleum Platforms in the Northern Gulf of Mexico. Ph.D. dissertation. Louisiana State University and Agricultural and Mechanical College. 193 pp. (Thesis/Dissertation).

ELVERS BANK

Campbell MD, Rademacher KR, Noble B, Salisbury J, Felts P, Moser J, Caillouet R, Hendon M, Driggers WB. 2019. Status and trends of Marbled Grouper in the North-Central Gulf of Mexico. Marine and Coastal Fisheries 11(2): 114-124. (Peer reviewed).

Nash HL, McLaughlin RJ. 2014. A policy approach to establish an international network of marine protected areas in the Gulf of Mexico region. Australian Journal of Maritime & Ocean Affairs 6(3): 119-153. (Peer reviewed).

Opresko DM, Goldman SL, Johnson R, Parra K, Nuttall M, Schmahl GP, Brugler MR. 2020. Morphological and molecular characterization of a new species of black coral from Elvers Bank, north-western Gulf of Mexico (Cnidaria: Anthozoa: Hexacorallia: Antipatharia: Aphanipathidae: Distichopathes). Journal of the Marine Biological Association of the United Kingdom 100(4): 559-566. (Peer reviewed).

GEYER BANK

Camacho Hadad OM. 2016. Systematics of Brown Macroalgae (Phaeophyceae) with an Emphasis on Taxa from the Western Atlantic and Gulf of Mexico. Ph.D. dissertation, University of Louisiana at Lafayette. 214 pp. (Thesis/Dissertation).

Campbell MD, Rademacher KR, Noble B, Salisbury J, Felts P, Moser J, Caillouet R, Hendon M, Driggers WB. 2019. Status and trends of Marbled Grouper in the North-Central Gulf of Mexico. Marine and Coastal Fisheries 11(2): 114-124. (Peer reviewed).

Creed JC, Fenner D, Sammarco P, Cairns S, Capel K, Junqueira AOR, Cruz I, Miranda RJ, Carlos-Junior L, Mantelatto MC, Oigman-Pszczol S. 2017. The invasion of the azooxanthellate coral Tubastraea (Scleractinia: Dendrophylliidae) throughout the world: history, pathways and vectors. Biological Invasions 19(1): 283-305. (Peer reviewed).

Figueroa DF, McClure A, Figueroa NJ, Hicks DW. 2019. Hiding in plain sight: invasive coral *Tubastraea tagusensis* (Scleractinia:Hexacorallia) in the Gulf of Mexico. Coral Reefs 38(3): 395-403. (Peer reviewed).

Gledhill CT. 2001. Reef Fish Assemblages on Gulf of Mexico Shelf-edge Banks. Ph.D. dissertation, University of South Alabama. 193 pp. (Thesis/Dissertation).

LeBlanc JU, Rezak R, Bright TJ. 1981. Northern Gulf of Mexico Topographic Features Study. Final Report. College Station, TX: Texas A & M University, Department of Oceanography. Submitted to the U.S. Department of the Interior, Bureau of Land Management, Outer Continental Shelf Office Technical Report No 81-2-T. 5 volumes. (Miscellaneous gray literature).

Nash HL, Furiness SJ, Tunnell JW. 2013. What was known About Species Richness and Distribution on the Outer-Shelf South Texas Banks? Gulf and Caribbean Research 25: 9-18. (Peer reviewed).

Nash HL, McLaughlin RJ. 2014. A policy approach to establish an international network of marine protected areas in the Gulf of Mexico region. Australian Journal of Maritime & Ocean Affairs 6(3): 119-153. (Peer reviewed).

Sammarco PW, Nuttall MF, Beltz D, Hickerson EL, Schmahl GP. 2016. Patterns of mesophotic benthic community structure on banks off vs inside the continental shelf edge, Gulf of Mexico. Gulf of Mexico Science 33(1): 77-92. (Peer reviewed).

Stewart JD, Nuttall M, Hickerson EL, Johnston MA. 2018. Important juvenile manta ray habitat at Flower Garden Banks National Marine Sanctuary in the northwestern Gulf of Mexico. Marine Biology 165(7): Article 11. (Peer reviewed).

Tolan JM. 2001. Patterns of Reef-Fish Larval Supply to Petroleum Platforms in the Northern Gulf of Mexico. Ph.D. dissertation. Louisiana State University and Agricultural and Mechanical College. 193 pp. (Thesis/Dissertation).

HORSESHOE BANK

Nash HL. 2013. Trinational Governance to Protect Ecological Connectivity: Support for Establishing an International Gulf of Mexico Marine Protected Area Network. Ph.D. dissertation, Texas A & M University - Corpus Christi. 218 pp. (Thesis/Dissertation).

Sammarco PW, Nuttall MF, Beltz D, Hickerson EL, Schmahl GP. 2016. Patterns of mesophotic benthic community structure on banks off vs inside the continental shelf edge, Gulf of Mexico. Gulf of Mexico Science 33(1): 77-92. (Peer reviewed).

Schulze A, Erdner DL, Grimes CJ, Holstein DM, Miglietta MP. 2020. Artificial Reefs in the Northern Gulf of Mexico: Community Ecology Amid the "Ocean Sprawl". Frontiers in Marine Science 7: Article 447. (Peer reviewed).

JAKKULA BANK

Campbell MD, Rademacher KR, Noble B, Salisbury J, Felts P, Moser J, Caillouet R, Hendon M, Driggers WB. 2019. Status and trends of Marbled Grouper in the North-Central Gulf of Mexico. Marine and Coastal Fisheries 11(2): 114-124. (Peer reviewed).

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

Glenn HD, Cowan JH, Powers JE. 2017. A comparison of red snapper reproductive potential in the northwestern Gulf of Mexico: Natural versus artificial habitats. Marine and Coastal Fisheries 9(1): 139-148. (Peer reviewed).

Nash HL, Furiness SJ, Tunnell JW. 2013. What was known About Species Richness and Distribution on the Outer-Shelf South Texas Banks? Gulf and Caribbean Research 25: 9-18. (Peer reviewed).

Nash HL, McLaughlin RJ. 2014. A policy approach to establish an international network of marine protected areas in the Gulf of Mexico region. Australian Journal of Maritime & Ocean Affairs 6(3): 119-153. (Peer reviewed).

Schwartzkopf BD, Langland TA, Cowan JH. 2017. Habitat selection important for red snapper feeding ecology in the Northwestern Gulf of Mexico. Marine and Coastal Fisheries 9(1): 373-387. (Peer reviewed).

Schwartzkoph BD, Cowan JH. 2017. Seasonal and sex differences in energy reserves of red snapper *Lutjanus campechanus* on natural and artificial reefs in the northwestern Gulf of Mexico. Fisheries Science 83(1): 13-22. (Peer reviewed).

Streich MK. 2016. Ecology of Red Snapper in the Western Gulf of Mexico: Comparisons among Artificial and Natural Habitats. Ph.D. dissertation, Texas A & M University - Corpus Christi. 195 pp. (Thesis/Dissertation.

MACNEIL BANK

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

McGrail DW, Rezak R, Bright TJ. 1982. Environmental Studies at the Flower Gardens and Selected Banks: Northwestern Gulf of Mexico, 1979-1981. Final Report. Northern Gulf of Mexico Topographic Features Study. Contract No. AA851-CTO-25. College Station, TX: Texas A & M University, Department of Oceanography. Submitted to the U.S. Department of the Interior, Bureau of Land Management, Outer Continental Shelf Office. Technical Report No. 82-7-T. 315 pp. (Miscellaneous gray literature).

PARKER BANK

Gledhill CT. 2001. Reef Fish Assemblages on Gulf of Mexico Shelf-edge Banks. Ph.D. dissertation, University of South Alabama. 193 pp. (Thesis/Dissertation).

Pontón DEV. 2017. Population Genetics and Ecological Structure in Macroalgal Communities from Offshore Banks Exposed to the Deepwater Horizon Oil Spill in the NW Gulf of Mexico. Ph.D. dissertation, University of Louisiana at Lafayette. 129 pp. (Thesis/Dissertation).

RANKIN BRIGHT BANK

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

REZAK SIDNER BANK

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

LeBlanc JU, Rezak R, Bright TJ. 1981. Northern Gulf of Mexico Topographic Features Study. Final Report. College Station, TX: Texas A & M University, Department of Oceanography. Submitted to the U.S. Department of the Interior, Bureau of Land Management, Outer Continental Shelf Office Technical Report No 81-2-T. 5 volumes. (Miscellaneous gray literature).

Streich MK. 2016. Ecology of Red Snapper in the Western Gulf of Mexico: Comparisons among Artificial and Natural Habitats. Ph.D. dissertation, Texas A & M University - Corpus Christi. 195 pp. (Thesis/Dissertation).

SONNIER BANK

Ajemian MJ, Wetz JJ, Shipley-Lozano B, Stunz GW. 2015. Rapid assessment of fish communities on submerged oil and gas platform reefs using remotely operated vehicles. Fisheries Research 167: 143-155. (Peer reviewed).

Ajemian MJ, Wetz JJ, Shipley-Lozano B, Shively JD, Stunz GW. 2015. An analysis of artificial reef fish community structure along the Northwestern Gulf of Mexico Shelf: Potential impacts of "Rigs-to-Reefs" programs. PLoS One 10(5): e0126354. (Peer reviewed).

Campbell MD, Rose K, Boswell K, Cowan J. 2011. Individual-based modeling of an artificial reef fish community: Effects of habitat quantity and degree of refuge. Ecological Modelling 222(23-24): 3895-3909. (Peer reviewed).

Creed JC, Fenner D, Sammarco P, Cairns S, Capel K, Junqueira AOR, Cruz I, Miranda RJ, Carlos-Junior L, Mantelatto MC, Oigman-Pszczol S. 2017. The invasion of the azooxanthellate coral Tubastraea (Scleractinia: Dendrophylliidae) throughout the world: history, pathways and vectors. Biological Invasions 19(1): 283-305. (Peer reviewed).

DeBose JL, Nuttall MF, Hickerson EL, Schmahl GP. 2012. A high-latitude coral community with an uncertain future: Stetson Bank, northwestern Gulf of Mexico. Coral Reefs 32(1): 255-267. (Peer reviewed).

Fredericq S, Phillips N, Gavio B. 2000. Observations on the macroalgae inhabiting deep-water hard bank communities in the Northwestern Gulf of Mexico. Gulf of Mexico Science 18(2): 88-96. (Peer reviewed).

Jordan LM. 2016. Characterizing Mesophotic Reef Fish Communities at Five South Texas Relic Coral-Algal Banks. M.S. Thesis, University of Texas Rio Grande Valley. 53 pp. (Thesis/Dissertation).

Kraus RT, Hill RL, Rooker JR, Dellapenna TM. 2006. Preliminary Characterization of a Mid-shelf Bank in the Northwestern Gulf of Mexico as Essential Habitat of Reef Fishes. Proceedings of the Gulf and Caribbean Fisheries Institute 57: 621-632. (Peer reviewed).

Leontiou AJ, Wu W, Brown-Peterson NJ. 2021. Immature and mature female Red Snapper habitat use in the north-central Gulf of Mexico. Regional Studies in Marine Science 44: Article 101715. (Peer reviewed).

Nash HL. 2013. Trinational Governance to Protect Ecological Connectivity: Support for Establishing an International Gulf of Mexico Marine Protected Area Network. Ph.D. dissertation, Texas A & M University - Corpus Christi. 218 pp. (Thesis/Dissertation).

Precht WF, Aronson RB, Deslarzes KJP, Robbart ML, Murdoch TJT, Gelber A, Evans DJ, Gearheart B, Zimmer B. 2006. Long-term Monitoring at the East and West Flower Garden Banks, 2002-2003: Final report. OCS Study MMS 2006-035. 182 pp. (Agency Report).

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2017. A comparison of fish community structure at mesophotic artificial reefs and natural banks in the western Gulf of Mexico. Marine and Coastal Fisheries 9(1): 170-189. (Peer reviewed).

Streich MK. 2016. Ecology of Red Snapper in the Western Gulf of Mexico: Comparisons among Artificial and Natural Habitats. Ph.D. dissertation, Texas A & M University - Corpus Christi. 195 pp. (Thesis/Dissertation).

Velez S. Juvenile Population Dynamics of Families Lutjanidae and Serranidae in the Gulf of Mexico, with Respect to the Loop Current and other Hydrographic Features. M.S. Thesis, Florida Atlantic University. 139 pp. (Thesis/Dissertation).

Wetmore LS, Dance MA, Hill RL, Rooker JR. 2020. Community dynamics of fish assemblages on mid-shelf and outer-shelf coral reefs in the northwestern Gulf of Mexico. Frontiers in Marine Science 7: Article 152. (Peer reviewed).

Wilson CA, Miller MW, Allen YC, Boswell KM, Nieland DL. 2006. Effects of Depth, Location, and Habitat Type on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico. Final Report. OCS Study MMS 2006-037. 85 pp. (Agency Report).

SOUTHWESTERN GoM

ARANSAS BANK

Nash HL, Furiness SJ, Tunnell JW. 2013. What was known About Species Richness and Distribution on the Outer-Shelf South Texas Banks? Gulf and Caribbean Research 25: 9-18. (Peer reviewed).

Rodriguez RE. 2015. Assessing Coral Assemblages Inhabiting Relic Coral Banks off the South Texas Coast. M.S. Thesis, University of Texas at Brownsville. 108 pp. (Thesis/Dissertation).

Rodriguez RE, Easton E, Shirley TC, Tunnell JW, Jr., Hicks D. 2018. Preliminary multivariate comparison of coral assemblages on carbonate banks in the western Gulf of Mexico. Gulf and Caribbean Research 29(1): 23-33. (Peer reviewed).

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2017. A comparison of fish community structure at mesophotic artificial reefs and natural banks in the western Gulf of Mexico. Marine and Coastal Fisheries 9(1): 170-189. (Peer reviewed).

BAKER BANK

Cooksey MT. 2016. Characterizing Benthic Invertebrate Communities at Five South Texas Banks. M.S. Thesis, University of Texas Rio Grande Valley. 88 pp. (Thesis/Dissertation).

Downey CH. 2016. Reproduction and Diet of Red Snapper *Lutjanus capechanus* on Natural and Artificial Reefs in the Northwestern Gulf of Mexico. M.S. Thesis, Texas A & M University. 66 pp. (Thesis/Dissertation).

Giammona CPJ. 1978. Octocorals in the Gulf of Mexico - Their Taxonomy and Distribution with Remarks on their Paleontology. Ph.D. dissertation, Texas A & M University. 260 pp. (Thesis/Dissertation).

Jordan LM. 2016. Characterizing Mesophotic Reef Fish Communities at Five South Texas Relic Coral-Algal Banks. M.S. Thesis, University of Texas Rio Grande Valley. 53 pp. (Thesis/Dissertation).

Khanna P, Droxler AW, Nittrouer JA, Tunnell JW, Jr., Shirley TC. 2017. Coralgal reef morphology records punctuated sea-level rise during the last deglaciation. Nature Communications 8(1): 1046. (Peer reviewed).

Rodriguez RE, Easton E, Shirley TC, Tunnell JW, Jr., Hicks D. 2018. Preliminary multivariate comparison of coral assemblages on carbonate banks in the western Gulf of Mexico. Gulf and Caribbean Research 29(1): 23-33. (Peer reviewed).

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2017. A comparison of fish community structure at mesophotic artificial reefs and natural banks in the western Gulf of Mexico. Marine and Coastal Fisheries 9(1): 170-189. (Peer reviewed).

Streich MK. 2016. Ecology of Red Snapper in the Western Gulf of Mexico: Comparisons among Artificial and Natural Habitats. Ph.D. dissertation, Texas A & M University - Corpus Christi. 195 pp. (Thesis/Dissertation).

BIG ADAM ROCK BANK

Clark RL, Siceloff L, Winship A. 2018. Mapping bottom-contact fishing intensity in the Gulf of Mexico in relation to predicted suitable habitats for deep sea corals. NOAA Technical Memorandum NOS NCCOS 242. 47 pp. (Agency Report).

Gallaway BJ, Szedlmayer ST, Gazey WJ. 2009. A life history review for red snapper in the Gulf of Mexico with an evaluation of the importance of offshore petroleum platforms and other artificial reefs. Reviews in Fisheries Science 17(1): 48-67. (Peer reviewed).

Jordan LM. 2016. Characterizing Mesophotic Reef Fish Communities at Five South Texas Relic Coral-Algal Banks. M.S. Thesis, University of Texas Rio Grande Valley. 53 pp. (Thesis/Dissertation).

Leuterman AJJ. 1979. The Taxonomy and Systematics of the Gymnolaemate and Stenolaemate Bryozoa of the Northwest Gulf of Mexico. Ph.D. dissertation, Texas A&M University. 328 pp. (Thesis/Dissertation).

Nash HL, Furiness SJ, Tunnell JW. 2013. What was known About Species Richness and Distribution on the Outer-Shelf South Texas Banks? Gulf and Caribbean Research 25: 9-18. (Peer reviewed).

BLACKFISH RIDGE

Giammona CPJ. 1978. Octocorals in the Gulf of Mexico - Their Taxonomy and Distribution with Remarks on their Paleontology. Ph.D. dissertation, Texas A & M University. 260 pp. (Thesis/Dissertation).

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

Jordan LM. 2016. Characterizing Mesophotic Reef Fish Communities at Five South Texas Relic Coral-Algal Banks. M.S. Thesis, University of Texas Rio Grande Valley. 53 pp. (Thesis/Dissertation).

Khanna P, Droxler AW, Nittrouer JA, Tunnell JW, Jr., Shirley TC. 2017. Coralgal reef morphology records punctuated sea-level rise during the last deglaciation. Nature Communications 8(1): 1046. (Peer reviewed).

Khanna P. 2017. Transgressive Reef Morphology Evolution: A Qualitative and Quantitative Comparison of Uppermost Pleistocene and Upper Cambrian Reefs in Offshore and Central Texas (USA). Ph,D dissertation, Rice University. 204 pp. (Thesis/Dissertation).

Nash HL, Furiness SJ, Tunnell JW. 2013. What was known About Species Richness and Distribution on the Outer-Shelf South Texas Banks? Gulf and Caribbean Research 25: 9-18. (Peer reviewed).

Nash HL, McLaughlin RJ. 2014. A policy approach to establish an international network of marine protected areas in the Gulf of Mexico region. Australian Journal of Maritime & Ocean Affairs 6(3): 119-153. (Peer reviewed).

Rodriguez RE. 2015. Assessing Coral Assemblages Inhabiting Relic Coral Banks off the South Texas Coast. M.S. Thesis, University of Texas at Brownsville. 108 pp. (Thesis/Dissertation).

Rodriguez RE, Easton E, Shirley TC, Tunnell JW, Jr., Hicks D. 2018. Preliminary multivariate comparison of coral assemblages on carbonate banks in the western Gulf of Mexico. Gulf and Caribbean Research 29(1): 23-33. (Peer reviewed).

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2017. A comparison of fish community structure at mesophotic artificial reefs and natural banks in the western Gulf of Mexico. Marine and Coastal Fisheries 9(1): 170-189. (Peer reviewed).

Streich MK. 2016. Ecology of Red Snapper in the Western Gulf of Mexico: Comparisons among Artificial and Natural Habitats. Ph.D. dissertation, Texas A & M University - Corpus Christi. 195 pp. (Thesis/Dissertation).

DREAM BANK

Giammona CPJ. 1978. Octocorals in the Gulf of Mexico - Their Taxonomy and Distribution with Remarks on their Paleontology. Ph.D. dissertation, Texas A & M University. 260 pp. (Thesis/Dissertation).

Khanna P, Droxler AW, Nittrouer JA, Tunnell JW, Jr., Shirley TC. 2017. Coralgal reef morphology records punctuated sea-level rise during the last deglaciation. Nature Communications 8(1): 1046. (Peer reviewed).

Pavliska CL. 2019. DNA Barcoding Reveals Unexpected Diversity in Octocorallia in the Northwest Gulf of Mexico. M.S. Thesis, University of Texas Rio Grande Valley. 76 pp. (Thesis/Dissertation).

Rodriguez RE, Easton E, Shirley TC, Tunnell JW, Jr., Hicks D. 2018. Preliminary multivariate comparison of coral assemblages on carbonate banks in the western Gulf of Mexico. Gulf and Caribbean Research 29(1): 23-33. (Peer reviewed).

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2017. A comparison of fish community structure at mesophotic artificial reefs and natural banks in the western Gulf of Mexico. Marine and Coastal Fisheries 9(1): 170-189. (Peer reviewed).

HOSPITAL/NORTH HOSPITAL BANK

Bright TJ, Rezak R. 1978. South Texas Topographic Features Study. New Orleans, LA: U.S. Department of the Interior. Bureau of Land Management. Outer Continental Shelf Office. 803 pp. (Agency Report).

Cooksey MT. 2016. Characterizing Benthic Invertebrate Communities at Five South Texas Banks. M.S. Thesis, University of Texas Rio Grande Valley. 88 pp. (Thesis/Dissertation).

Jordan LM. 2016. Characterizing Mesophotic Reef Fish Communities at Five South Texas Relic Coral-Algal Banks. M.S. Thesis, University of Texas Rio Grande Valley. 53 pp. (Thesis/Dissertation).

Khanna P. 2017. Transgressive Reef Morphology Evolution: A Qualitative and Quantitative Comparison of Uppermost Pleistocene and Upper Cambrian Reefs in Offshore and Central Texas (USA). Ph,D dissertation, Rice University. 204 pp. (Thesis/Dissertation).

MYSTERIOUS BANK

Clark RL, Siceloff L, Winship A. 2018. Mapping bottom-contact fishing intensity in the Gulf of Mexico in relation to predicted suitable habitats for deep sea corals. NOAA Technical Memorandum NOS NCCOS 242. 47 pp. (Agency Report).

Cooksey MT. 2016. Characterizing Benthic Invertebrate Communities at Five South Texas Banks. M.S. Thesis, University of Texas Rio Grande Valley. 88 pp. (Thesis/Dissertation).

Jordan LM. 2016. Characterizing Mesophotic Reef Fish Communities at Five South Texas Relic Coral-Algal Banks. M.S. Thesis, University of Texas Rio Grande Valley. 53 pp. (Thesis/Dissertation).

Nash HL, McLaughlin RJ. 2014. A policy approach to establish an international network of marine protected areas in the Gulf of Mexico region. Australian Journal of Maritime & Ocean Affairs 6(3): 119-153. (Peer reviewed).

Nash HL. 2013. Trinational Governance to Protect Ecological Connectivity: Support for Establishing an International Gulf of Mexico Marine Protected Area Network. Ph.D. dissertation, Texas A & M University - Corpus Christi. 218 pp. (Thesis/Dissertation).

SOUTH TEXAS BANKS - VARIOUS

Gil-Agudelo DL, Cintra-Buenrostro CE, Brenner J, González-Díaz P, Kiene W, Lustic C, Pérez-España H. 2020. Coral reefs in the Gulf of Mexico large marine ecosystem: conservation status, challenges, and opportunities. Frontiers in Marine Science 6: Article 807. (Peer reviewed).

Gittings SR, Bright TJ, Schroeder WW, Sager WW, Laswell SJ, Rezak R. 1992. Invertebrate assemblages and ecological controls on topographic features in the Northeast Gulf of Mexico. Bulletin of Marine Science 50(3): 435-455. (Peer reviewed).

Nash HL, Furiness SJ, Tunnell JW. 2013. What was known About Species Richness and Distribution on the Outer-Shelf South Texas Banks? Gulf and Caribbean Research 25: 9-18. (Peer reviewed).

Pavliska CL. 2019. DNA Barcoding Reveals Unexpected Diversity in Octocorallia in the Northwest Gulf of Mexico. M.S. Thesis, University of Texas Rio Grande Valley. 76 pp. (Thesis/Dissertation).

Appendix B: Data Compilation Results

Provided separately in Excel

Tab 1. Matrix showing literature review data compilation for individual project sites

Tab 2. Matrix showing distances and coordinates for individual project sites

Tab 3. Matrix showing data sources for distances and coordinates

Tab 4. Matrix showing data source type by site

Tab 5. Matrix showing vulnerability assessment