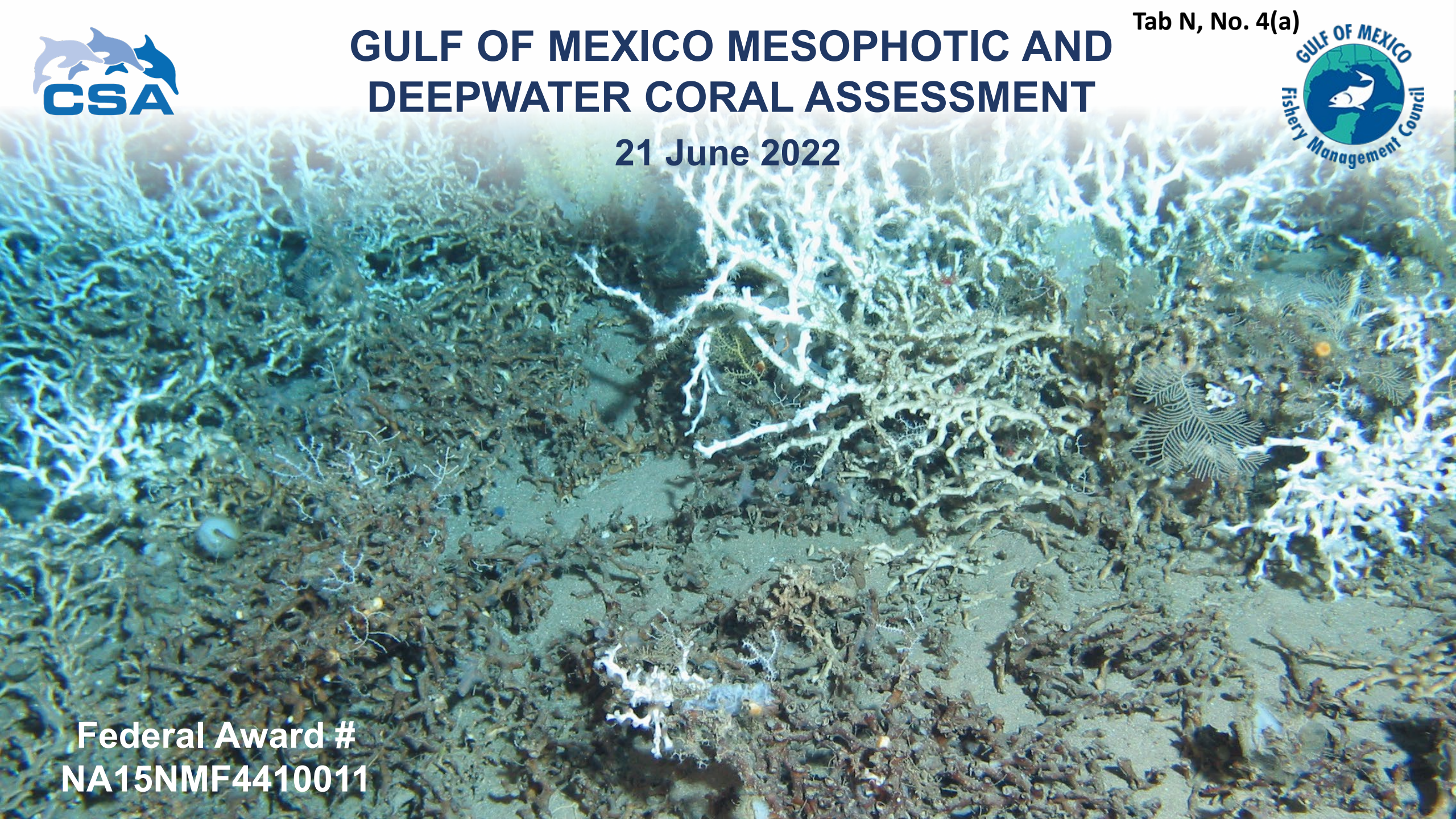
Tab N, No. 4(a)

GULF OF MEXICO MESOPHOTIC AND DEEPWATER CORAL ASSESSMENT

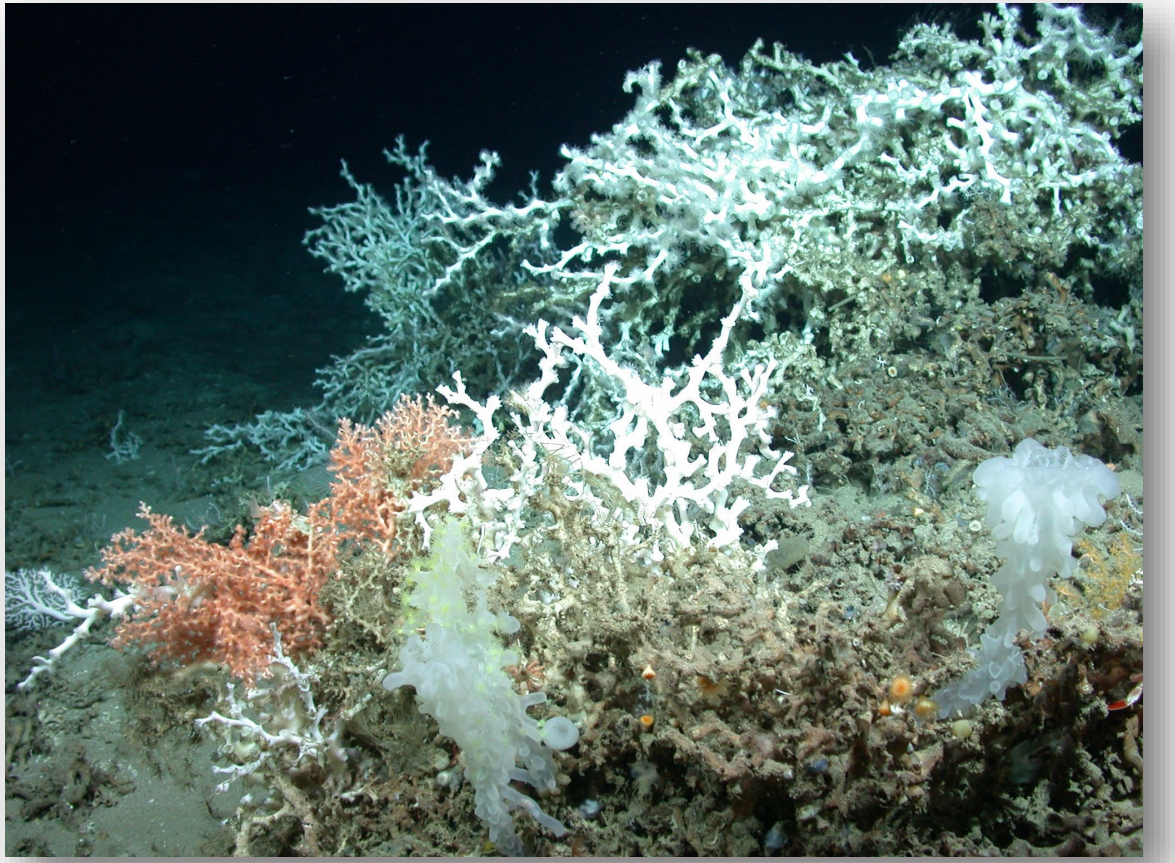
21 June 2022



Federal Award #
NA15NMF4410011

PROJECT PURPOSE

1. Compile and synthesize information on selected Gulf of Mexico deep-reef habitats.
2. Design and conduct a general ecological assessment of potential risks to these selected habitats and the services that they provide, providing to the extent practical details for comparison among habitats.



PROJECT TASKS

1. Select deep-reef areas (study sites) for analysis.
2. Review literature of the selected sites.
3. Design and produce an ecological assessment of the selected sites.
4. Design a web-based dashboard with an interactive map displaying the shape/area, coordinates, and pertinent information related to selected sites.

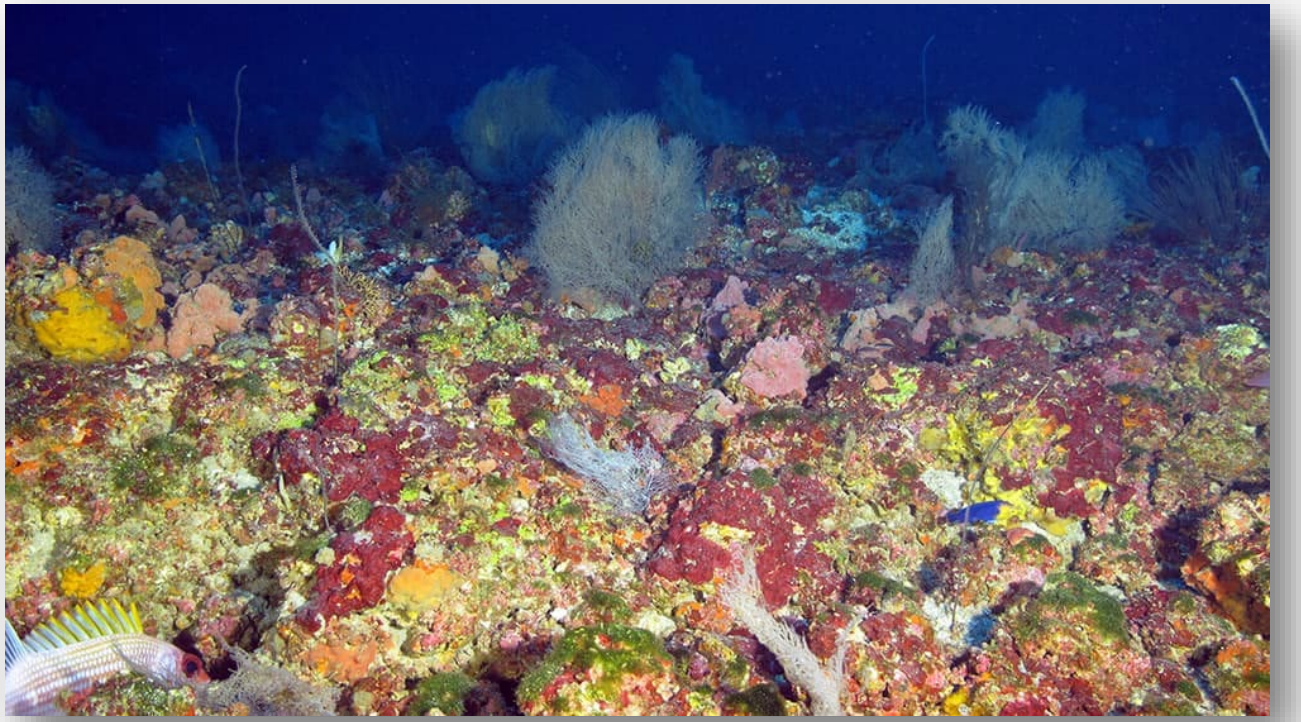
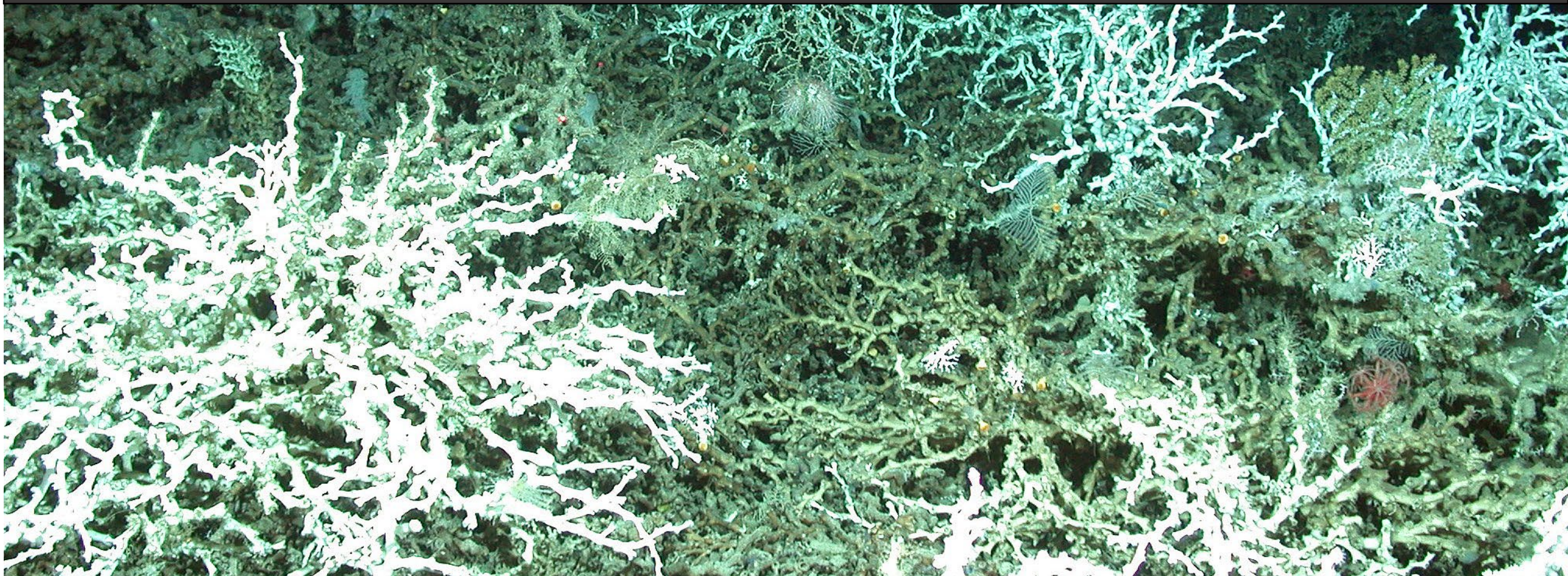


Image source: NOAA.gov

TASK 1 – SELECTION OF DEEP-REEF AREAS FOR ANALYSIS

"The project will focus on mesophotic (30 – 150 m) and deep-water corals (deeper than 50 m) in federal waters of the Gulf of Mexico from 9 to 200 nautical miles offshore. "

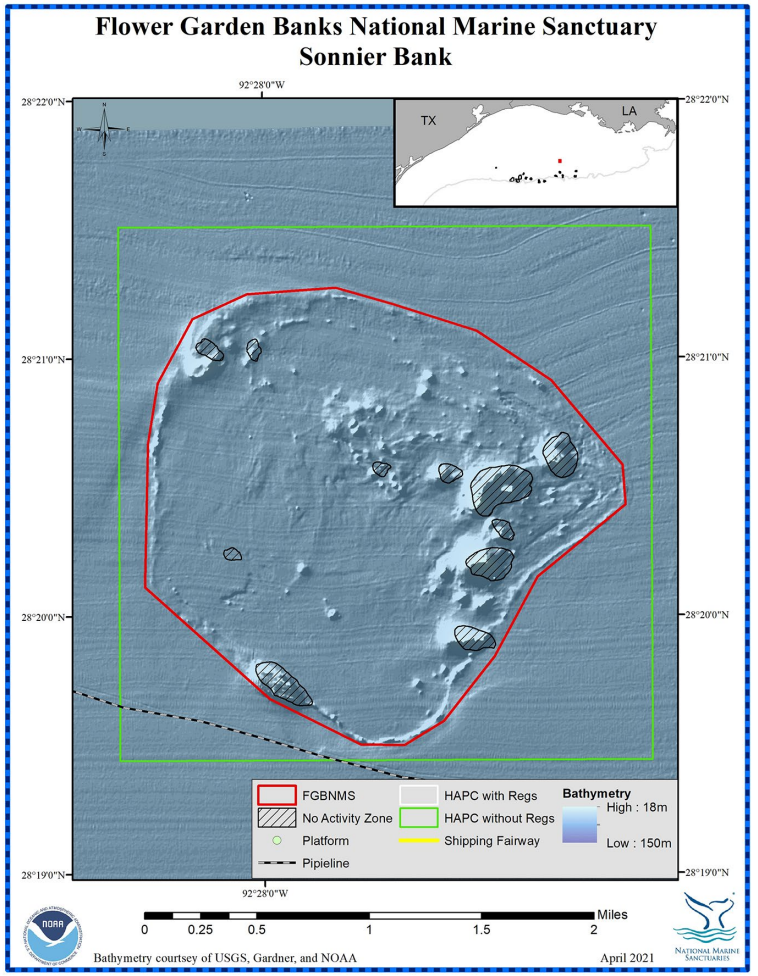


SELECTION OF DEEP-REEF AREAS FOR ANALYSIS

- The Council supplied information and reports, including the 2018 Coral Amendment 9, that provided lists of coral areas (termed project sites) for review that include existing designated HAPCs that may benefit from additional management measures.
- Additional areas of deep-reef habitats in the region were reviewed as potential candidate sites, based on CSA Team experience.
- From this initial review, a preliminary list of **67 project sites** distributed within four major regions of the Gulf of Mexico (GoM) were proposed for this project.
- The Council and the CSA Team discussed the preliminary list of sites, and it was decided to eliminate some locations from the list because they had already received some level of protection.
- The revised and final list included **44 project sites**, which included three “megasites” (defined as a larger conglomerate of sites, which includes a subset of individual project sites).

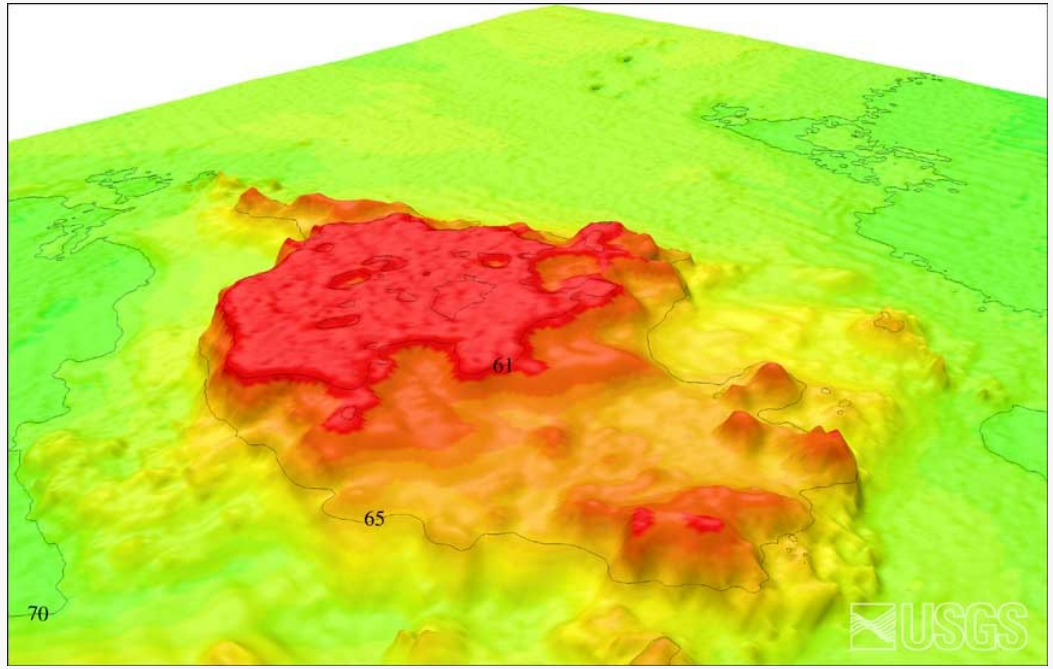
SELECTION OF DEEP-REEF AREAS FOR ANALYSIS
FINAL PROJECT SITE LIST

Region	Area	Site	
		Number	Name
SOUTHEASTERN GoM	Northern West Florida Slope	1	Northern West Florida Slope (Megasite)
		2	North Reed Site
		3	Long Mound
		4	Many Mounds
		5	West Florida Wall
	Southern West Florida Slope	6	Southern West Florida Slope (Megasite)
		7	Okeanos Ridge
NORTHEASTERN GoM	Pinnacles Reefs	8	Pinnacles Reefs (Megasite)
		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
		18	Cats Paw Reef
		19	Porgy Reef
		20	Yellowtail Reef
	DeSoto Canyon	21	DeSoto Canyon Rim
	Destin Dome	22	Destin Dome 51/52
		23	Destin Dome 99; 55/56/57
		24	Destin Dome 617

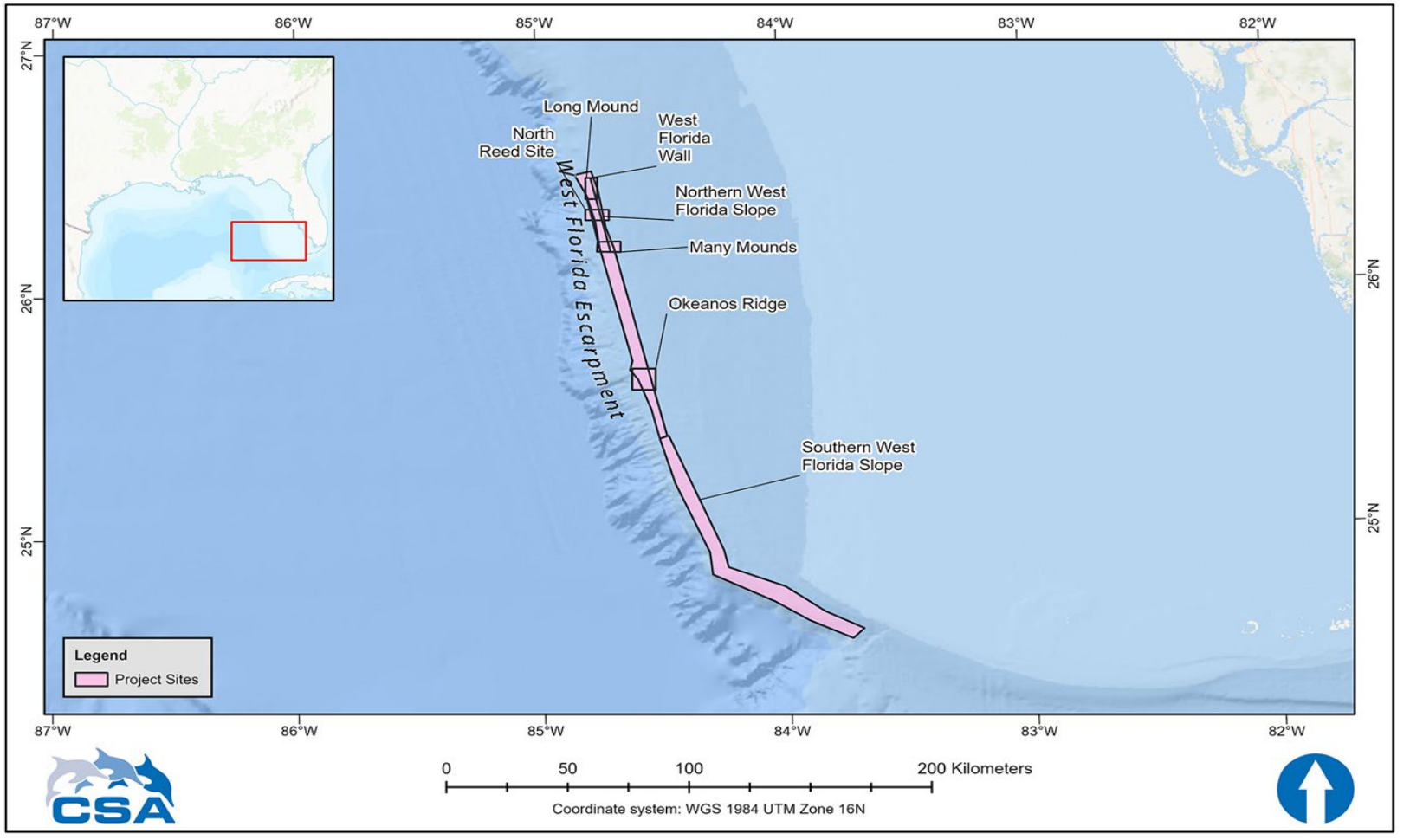


SELECTION OF DEEP-REEF AREAS FOR ANALYSIS
FINAL PROJECT SITE LIST

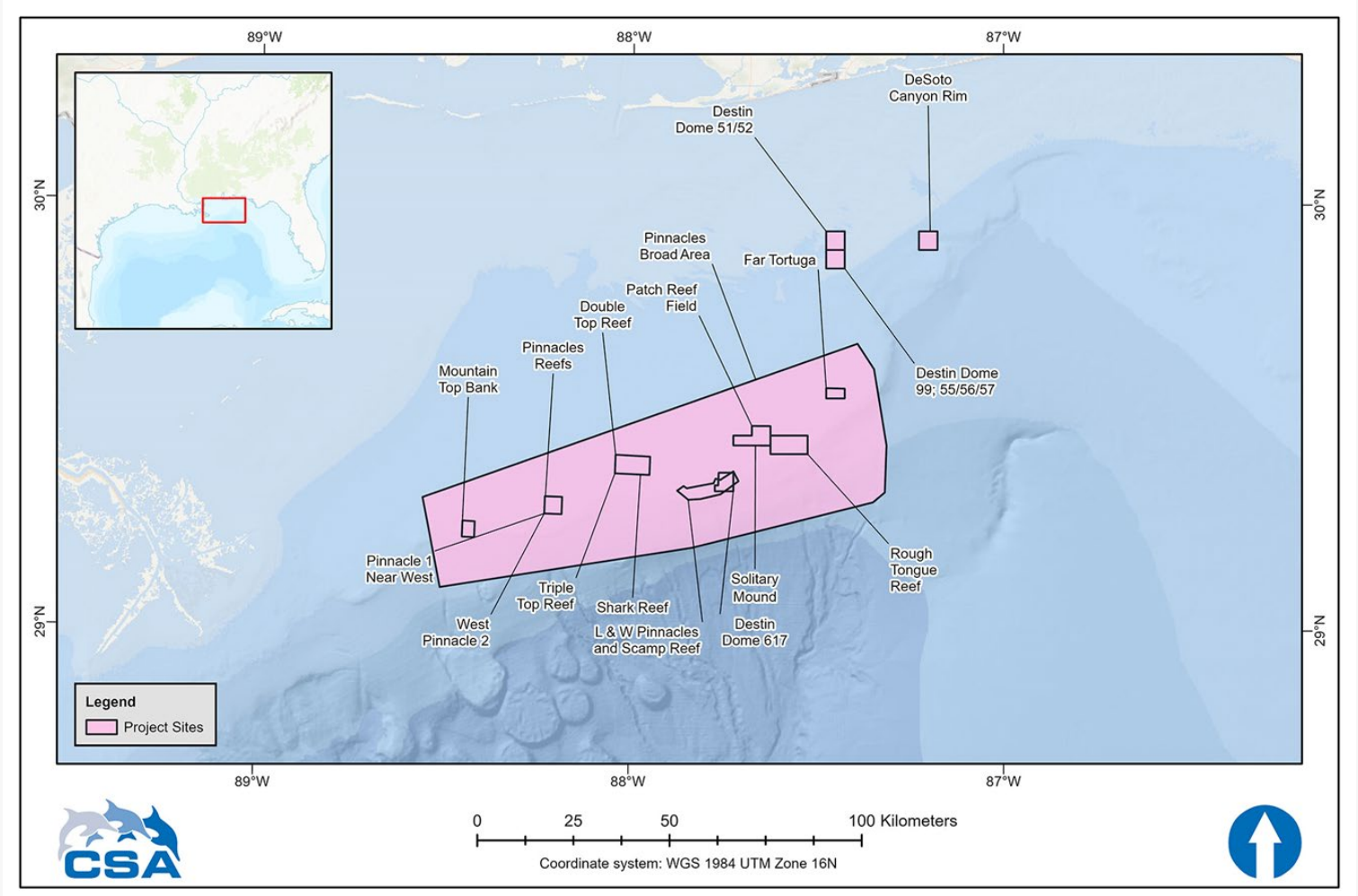
Region	Area	Site	
		Number	Name
NORTHWESTERN GoM	Shelf-Edge Banks	25	Sonnier Bank
		26	29-Fathom Bank
		27	MacNeil Bank
		28	Alderdice Bank
		29	Bouma Bank
		30	Horseshoe Bank
		31	Rankin Bright Bank
		32	Geyer Bank
		33	Elvers Bank
		34	Rezak Sidner Bank
		35	Parker Bank
		36	Jakkula Bank
SOUTHWESTERN 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



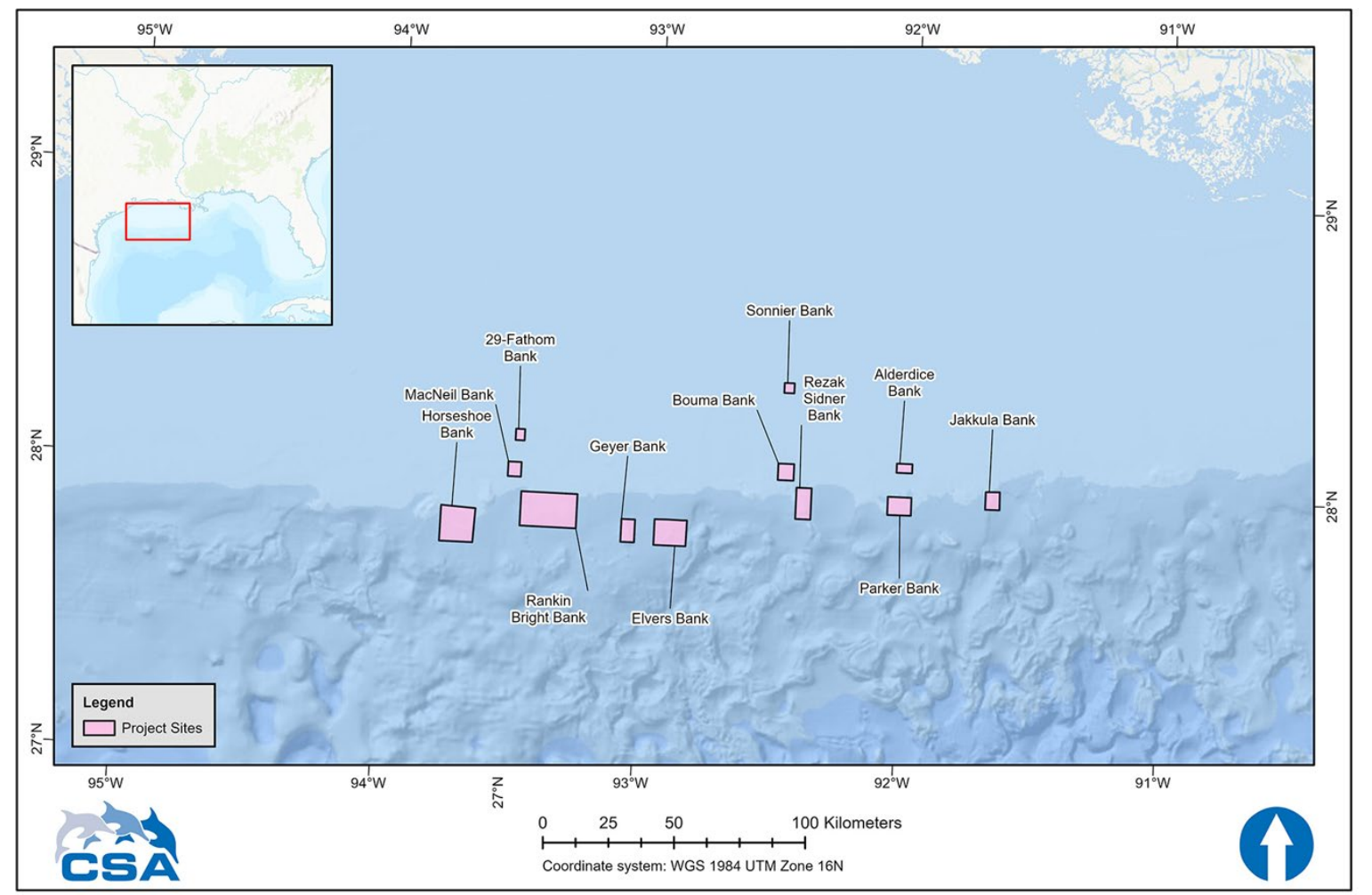
DISTRIBUTION OF PROJECT SITES: SE GoM REGION - WEST FLORIDA SLOPE



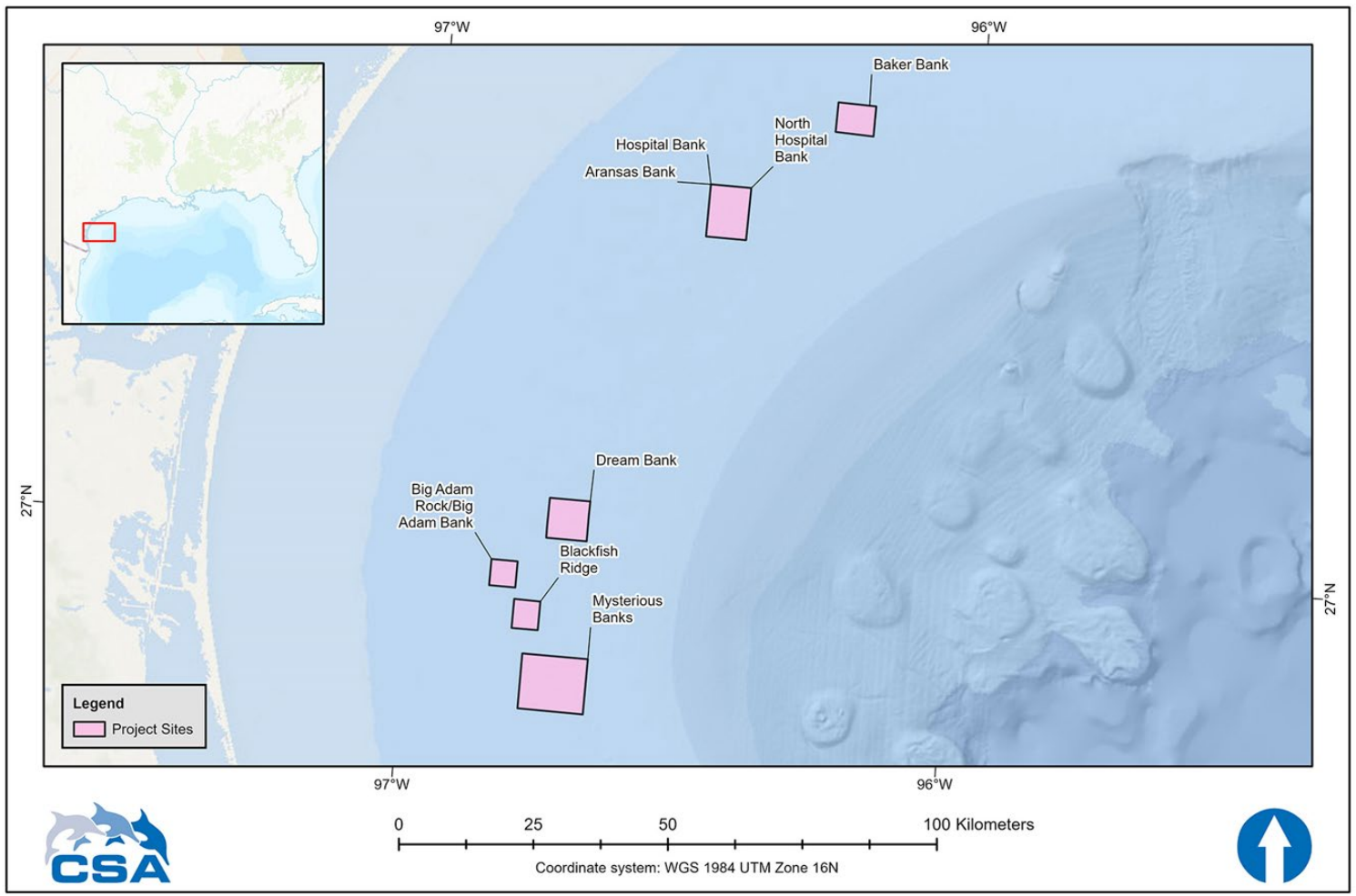
DISTRIBUTION OF PROJECT SITES: NE GoM REGION - THE PINNACLES



DISTRIBUTION OF PROJECT SITES: NW GoM REGION - SHELF-EDGE BANKS



DISTRIBUTION OF PROJECT SITES: NW GoM REGION - SOUTH TEXAS BANKS



TASK 2 – COMPREHENSIVE LITERATURE REVIEW

"Conduct a comprehensive literature review of the selected coral areas (providing citations and source information for each area/region considered, in Mendeley compatible bibliographic format [e.g., RIS])."

COMPREHENSIVE LITERATURE REVIEW

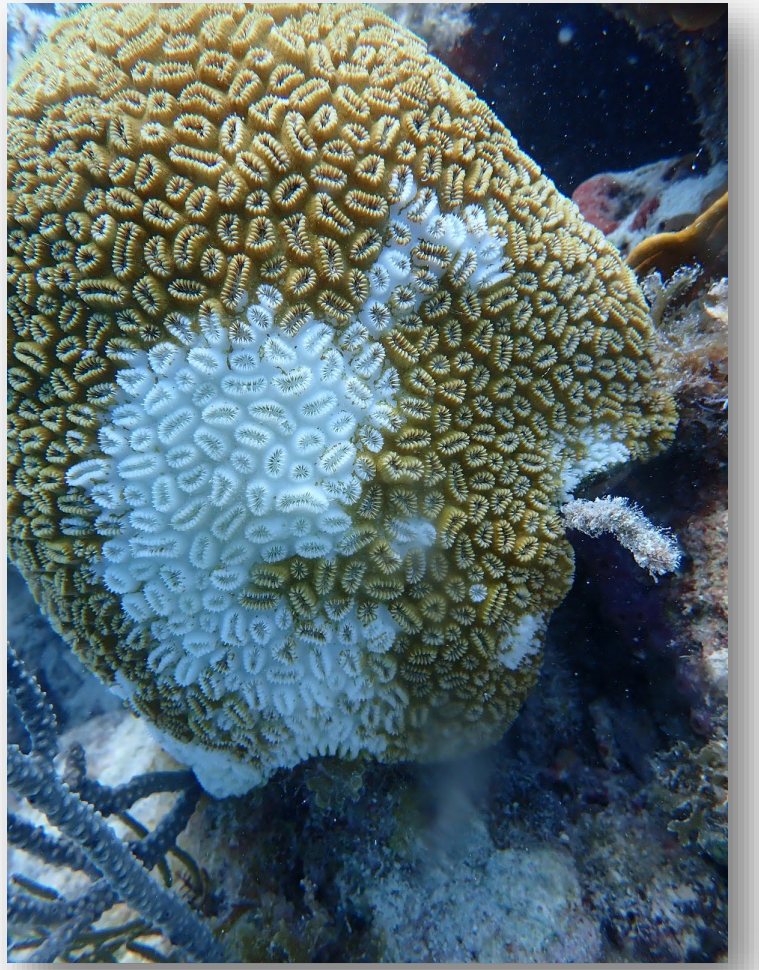
- An extensive search of scientific and technical databases was made using Proquest Dialog™. Relevant books, proceedings, technical reports, and gray literature were also located using OCLC WorldCat.
- These searches resulted in an unmanageable number of citations relative to the scope of the project. Our general search had to be year limited because we did not have resources to examine > 3,000 papers; however, some earlier papers and reports were essential to include.
- Searches were hindered by the adoption of colloquial names for discrete locations.
- From the search and review tasks, an Endnote™ X9 library was created for all documents used in the project which includes full citations with a PDF of the document attached. 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.

TASK 3 – ECOLOGICAL ASSESSMENT OF SELECTED PROJECT SITES

"Design and produce a general ecological assessment of those areas where corals are identified as a conspicuous element of the bottom, and potential risks to corals in those areas and the services that they provide."

ECOLOGICAL ASSESSMENT: SUBTASKS

1. Identify a consistent level of detail for comparisons among areas.
2. Provide information on selected project sites for pertinent environmental and physical factors that have known, accepted, and defensible ecological relevance.
3. Include economically important fishery species and impacts from commercial fishing activities.
4. Design a ranking strategy for selected factors and ultimately the project sites, based on ecological function which the Council could use to prioritize the development of management measures.



ECOLOGICAL ASSESSMENT: MATRIX DESIGN

A matrix was adopted for data compilation and assessment of environmental and physical factors. 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.
- The list of physical and environmental factors was developed and entered as separate columns on the top row) of the table.

The completed matrix provided a synoptic presentation of area-specific information that was used for site comparisons and rankings as part of the ecological assessment. The matrix was designed to be modified and improved as needed and as new data become available.

ECOLOGICAL ASSESSMENT: ENVIRONMENTAL AND PHYSICAL FACTORS

- Area
- Relief
- Depth
- Base Substratum
- Temperature Regime
- Salinity Regime
- Proximity to:

  Shore; Major River(s); Active Offshore Oil and Gas Activities; Wind Fields; Offshore Mining Operations; Shipping Lane(s); Other Protected Areas; Consistent Military Operations; Dumping Areas; and Benthic Methane Seeps

ECOLOGICAL ASSESSMENT: ENVIRONMENTAL AND PHYSICAL FACTORS

- Taxonomic Richness:

  Scleractinians, Octocorals, Hydrozoan Corals (Orders Milleporina and Stylasterina); Antipatharians, and Fishes

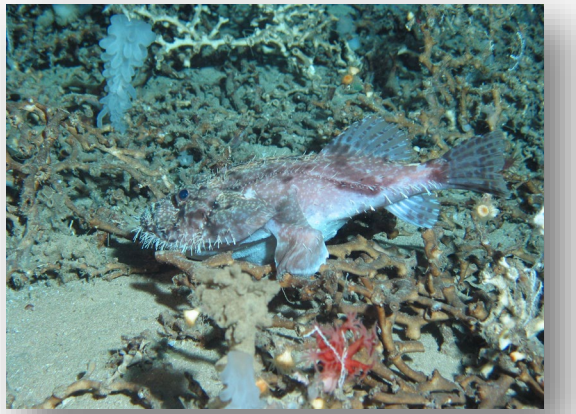
- Benthic Fishing Activity/Intensity:

  Bottom Long Line (BLL) and Bottom Trawl Fishing

- Benthic Fishery Types and Gears at Site
- Invasive Species
- Disease Incidence
- Research History
- Current Protections
- Vulnerability to Climate Change

ECOLOGICAL ASSESSMENT: DATA COMPILATION

- Throughout the project, the CSA Team worked closely with the Council to refine the structure and content of the tasks related to data review and compilation.
- Information pertaining to selected factors was entered into corresponding matrix cells for each project site.
- Sources of information or data used to populate each matrix cell were embedded in the cell as a note.
- Distance/proximity of physical factors to project sites were listed in a separate matrix table to retain detail.



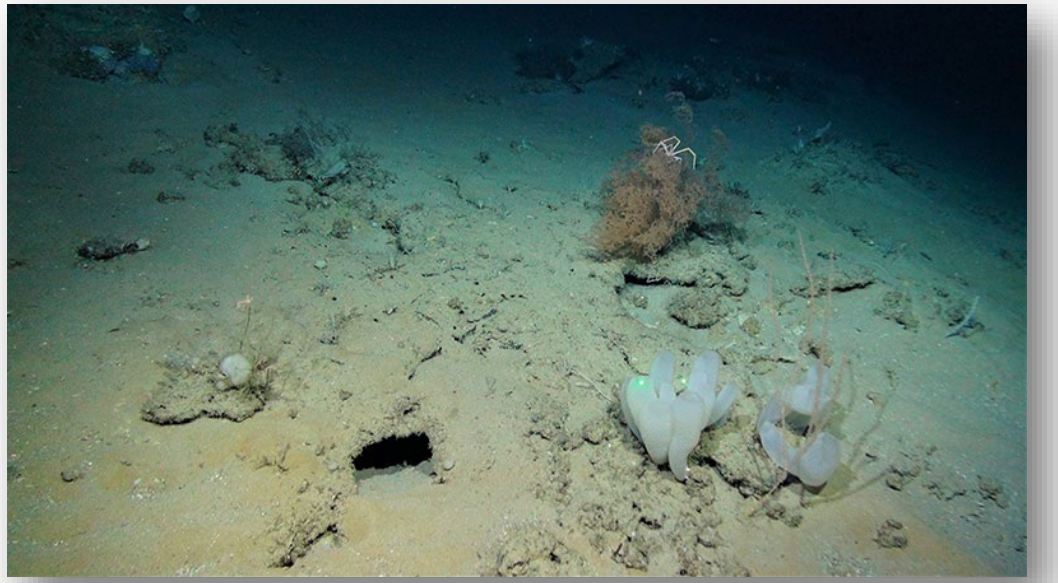
ECOLOGICAL ASSESSMENT: DATA COMPILATION RESULTS

Environmental Factors for Selected GoM Project Sites Based on a Search and Review of Literature

PROJECT SITE	ENVIRONMENTAL FACTORS FOR SELECTED GULF OF MEXICO PROJECT SITES BASED ON A SEARCH AND REVIEW OF LITERATURE																																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22							23		24	25	26	27	28
	AREA (ha)	RELIEF (m)	DEPTH (m)	BASE SUBSTRATUM	TEMPERATURE REGIME (°C)	SALINITY REGIME	CLOSEST PROX. TO SHORE (km)	CLOSEST PROX. TO MAJOR RIVER (km)	CLOSEST PROX. TO ACTIVE O&G FACILITY (km)	CLOSEST PROX. TO WIND FIELD (km)	CLOSEST PROX. TO MINING (km)	CLOSEST PROX. TO MAJOR SHIPPING LANE (km)	CLOSEST PROX. TO OTHER PROTECTED AREA (km)	CLOSEST PROX. TO MILITARY OPERATIONS (km)	CLOSEST PROX. TO DUMPING AREA (km)	CLOSEST PROX. TO ACTIVE METHANE SEEP (km)	SCLERACTINIAN CORAL TAXONOMIC RICHNESS (# OF GENERA)	OCTOCORAL TAXONOMIC RICHNESS (# OF GENERA)	HYDROZOAN CORAL TAXONOMIC RICHNESS (# OF GENERA)	ANTIPATHARIAN CORAL TAXONOMIC RICHNESS (# OF GENERA)	FISH TAXONOMIC RICHNESS (# OF SPECIES)	FISHING ACTIVITY(IES)	FISHING INTENSITY - BLL (Min. # of Vessel Positions)	FISHING INTENSITY - BLL (Max. # of Vessel Positions)	FISHING INTENSITY - BLL (Mean # of Vessel Positions)	FISHING INTENSITY - BENTHIC TRAWL (Min. Hrs.)	FISHING INTENSITY - BENTHIC TRAWL (Max. Hrs.)	FISHING INTENSITY - BENTHIC TRAWL (Mean Hrs.)	FISHERY TYPE(S)	FISHERY GEAR	INVASIVE SPECIES	DISEASE INCIDENCE	RESEARCH HISTORY	CURRENT PROTECTIONS	VULNERABILITY TO CLIMATE CHANGE
SOUTHEASTERN GULF OF MEXICO																																			
Northern West Florida Slope*	62529.6	24	368-757	Carbonate scarp with mixed rocks and boulders	6-27.0	34.9-36.2	229.9	266.0	355.3	n/a	n/a	60.7	66.1	0.0	181.0	87.2	2	2	1	2	50	Seasonal	1	13	4.2				Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	20		
North Reed Site	4664.7	8	300-900	Carbonate mounds and sand	~5.2-30	34.9-36	239.0	260.7	329.0	n/a	n/a	98.5	80.0	0	141.3	141.3	2	2	1	2	50	Seasonal	2	2	2	0	50	25	Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	4	Proposed for HAPC status with or without fishing regulations	
Long Mound	4664.7	20	300-700	Carbonate mounds and sand	~5.2-30	34.9-36	235.4	259.5	322.0	n/a	n/a	109.9	86.8	0	129.0	129.0	1	3	1	2	50	Seasonal	1	1	1				Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	5	Proposed for HAPC status with or without fishing regulations	
Many Mounds	4458.9	24	199-700	Carbonate mounds and sand	~5.2-30	34.9-36	243.1	261.0	339.6	n/a	n/a	83.6	71.8	0	156.5	156.5	1	3	1	1	50	Seasonal	38	38	38				Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	5	Proposed for HAPC status with or without fishing regulations	
West Florida Wall	12450.6	6–37	399-602	Carbonate ledges and boulders	6-27.0	35-36.5	239.8	261.3	329.2	n/a	n/a	97.7	80.0	0	142.3	142.3	2	4	1	1	50	Seasonal	1	10	4.3				Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	7	Proposed for HAPC status with or without fishing regulations	
Southern West Florida Slope*	81270.8	34	368-757	Carbonate scarp with mixed rocks and boulders	6-27.0	34.9-36.2	120.6	283.9	478.0	n/a	n/a	79.8	10.7	0	318.0	201.3	2	4	1	1		Seasonal	1	186	23.35				Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	19		
Okeanos Ridge	12347.7	34	300-701	Carbonate wall	~5.2-30	34.9-36	201.0	276.0	382.0	n/a	n/a	26.6	57.7	0	218.5	124.5	3	4	1	2		Seasonal	1	5	3	0	50	25	Commercial, Recreational(?); Golden crab, Finfish	Bottom longline; electric (bandit) reelhook and line; traps		Not observed	3		

ECOLOGICAL ASSESSMENT: RANKING OF ENVIRONMENTAL FACTORS AND FINAL SCORING METHODS

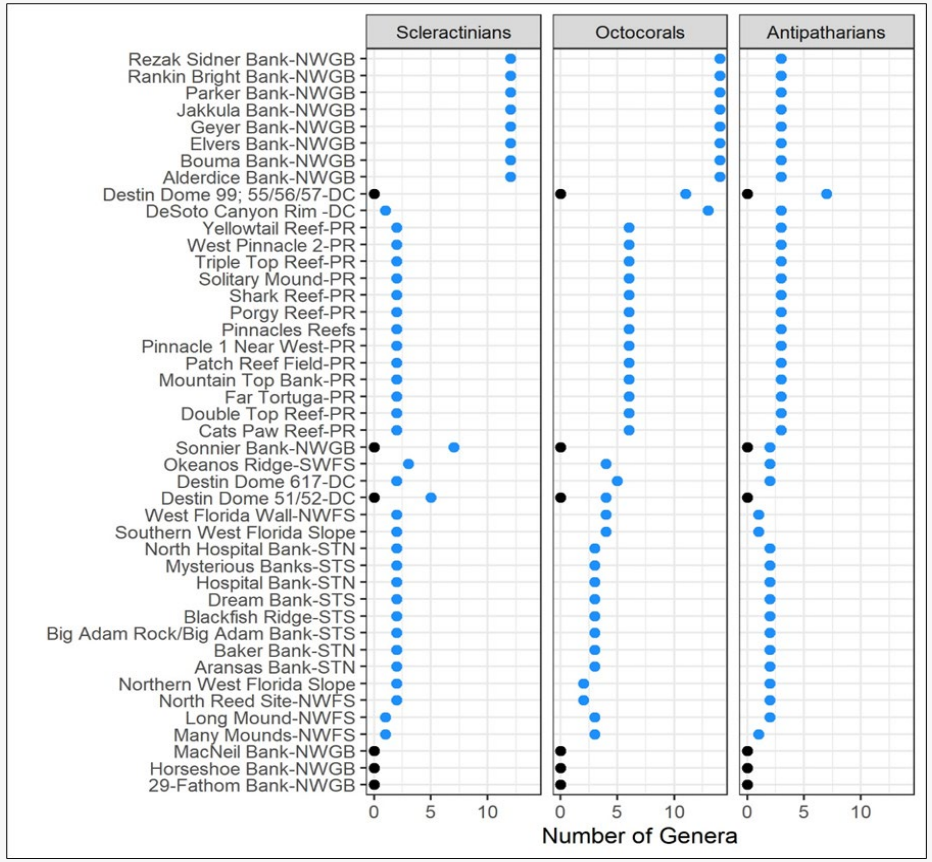
- Distribution graphs of data were generated for 18 factors with sufficient quantitative data, and patterns (or groupings) among sites were examined.
- Points were assigned to groups of data to separate sites across a spectrum of relative “quality” and/or “vulnerability.”
- Point assignments were additionally weighted for two of the factors: Area and Research History.
- For one factor that was not quantitative (Substrate), points were assigned based on research or management criteria.

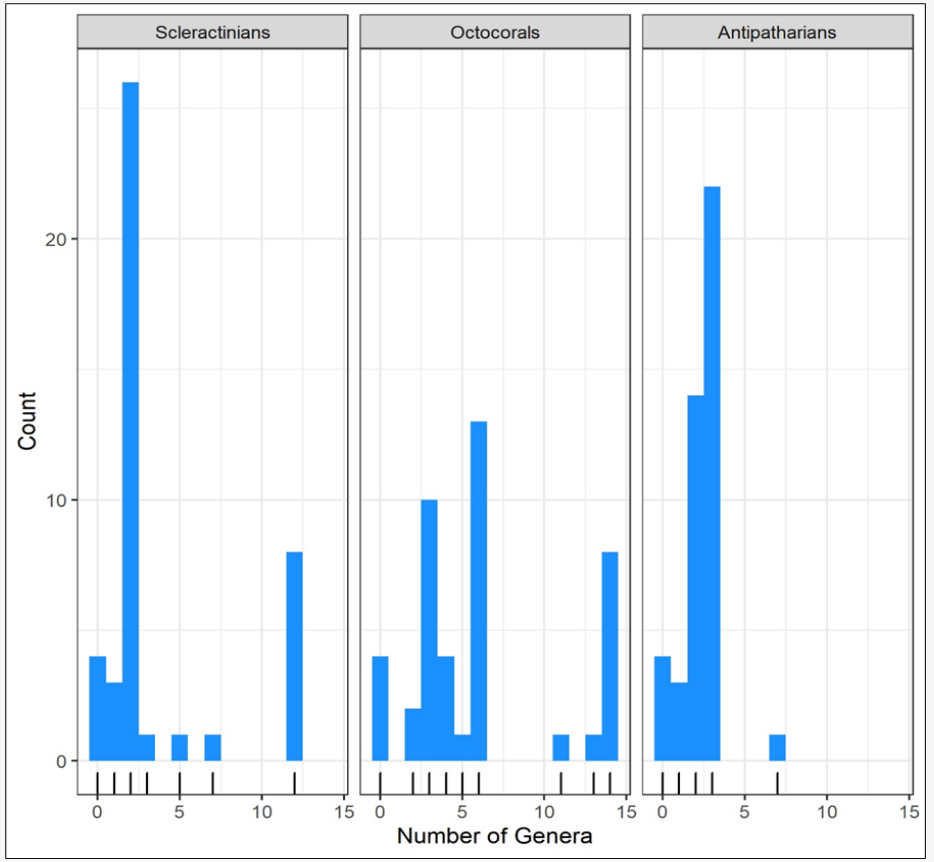


Note, assigned point values were designed to allow groupings of similar sites, as well as to give separation to the sites to easily visualize relative positions and data sufficiency

ECOLOGICAL ASSESSMENT: RANKING – DISTRIBUTIONAL GRAPHS

Site factors represented by numerical values were plotted by value (left figure) and as frequency distributions (right figure), which were used to categorize the range of factor values as well as the continuity of data and the shapes of frequency plots.





ECOLOGICAL ASSESSMENT:
RANKING – SCORING OF SELECTED FACTORS

Factor	Ranking			
	Group I	Group II	Group III	Group IV
Area	>27,800 ha = 5	229-27,800 ha = 4	<229 ha = 2	
Vertical Relief	>20 m = 5	6-20 m = 4	<6 m = 2	
Depth	>500 m = 2	< 250 m = 1		
Base Substratum	Coral = 5	Carbonate Rock = 3	Consolidated Sediment = 2	
Temperature Regime	Not Used			
Salinity Regime	Not Used			
Proximity to Shore	>125 km = 4	70-200 km = 2	<70 km = 1	
Proximity to O&G Activity	>300 km = 5	10-80 km = 3	<10 km = 1	
Proximity to Wind Field	Not Used			
Proximity to Ocean Mining	Not Used			
Proximity to Shipping Lane	>50 km = 3	<40 km = 1		
Proximity to Major River	>220 km = 3	110-220 km = 2	<100 km = 1	
Proximity to Other Protected Areas	<50 km = 5	50-120 km = 3	>130 km = 0	
Proximity to Consistent Military Operations	Not Used			
Proximity to Dumping Areas	>150 km = 5	50-150 km = 3	<50 km = 1	
Proximity to Benthic Methane Seeps	<10 km = 5	10-50 km = 3	>80 km = 0	
Taxonomic Richness - Scleractinia	>10 genera = 5	5-10 genera = 4	<5 genera = 3	
Taxonomic Richness - Octocorallia	>10 genera = 5	4-6 genera = 4	<4 genera = 3	
Taxonomic Richness - Hydrocorals	Not Used			
Taxonomic Richness - Antipatharians	>5 genera = 4	<5 genera = 3		
Taxonomic Richness - Fishes	30-50 species = 5	20-29 species = 4	< 20 species = 3	
Bottom Longline Activity	No VMS counts = 5	1-1000 VMS counts = 4	1001-2000 VMS counts = 3	>2000 VMS counts = 0
Bottom Trawling Activity	No activity = 4	1-50 mean hrs. = 3	50-3000 hrs. = 2	>3000 hrs. = 1
Invasive Species	No invasive species = 1	Any invasive species = 0		
Disease Incidence	No known coral diseases = 1	Any known coral diseases = 0		
Research History (weighted)	Peer-reviewed x 4; grad degree lit x 3; agency reports x 2; gray lit =0			
	>33 = 5	10-32 = 4	<10 = 2	0 = 0
Current Protections	Some protection = 3	No protection = 0		
Vulnerability to Climate Change	Not Used			

ECOLOGICAL ASSESSMENT: RESULTS

Project Site	Weighted Environmental Factors																			Totals
	Area (ha)	Relief (m)	Depth (m)	Base Substratum	Closest Prox. to Shore (km)	Closest Prox. to Major River (km)	Closest Prox. to Active O&G Facility (km)	Closest Prox. to Major Shipping Lane (km)	Closest Prox. to Other Protected Area (km)	Closest Prox. to Dumping Area (km)	Closest Prox. to Active Methane Seep (km)	Scleractinian Coral Taxonomic Richness	Octocoral Taxonomic Richness	Antipatharian Coral Taxonomic Richness	Fish Taxonomic Richness	Fishing Intensity (BII-Mean)	Fishing Intensity (Trawl-Mean)	Invasive Species	Research History	Current Protections	
SOUTHEASTERN GULF OF MEXICO																				
Northern West Florida Slope*	8	5	2	3	4	3	5	3	3	5	0	3	3	3	5	4	4	1	5	3	72
North Reed Site	4	4	2	3	4	3	5	3	3	3	0	3	3	3	5	4	3	1	4	3	63
Long Mound	4	4	2	3	4	3	5	3	3	3	0	3	4	2	5	4	4	1	4	3	64
Many Mounds	4	5	2	3	4	3	5	3	3	5	0	3	4	2	5	4	4	1	4	3	67
West Florida Wall	4	5	2	3	4	3	5	3	3	3	0	3	4	2	5	4	4	1	4	3	65
Southern West Florida Slope*	8	5	2		4	3	5	3	5	5	0	3	3	2		4	4	1	5	0	62
Okeanos Ridge	5	5	2	3	4	3	5	1	3	5	0	3	4	3		4	3	1	8	0	62

STUDY RECOMMENDATIONS

1) **Adding Additional Sites:** The value of these site comparisons can be increased substantially 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.
2) **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. For example:
    - **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.
    - **Coral data**: the emphasis on and importance of deep-water corals throughout this process contrasted sharply with the lack of coral data.
3) **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. In this study, comparisons of the corals present at each site were restricted to genera (as the lowest common taxonomic unit); however, improving site coral lists to the species level is desirable.
4) **More detailed analyses:** The utility of many of the factors in the matrix might be improved by more detailed analysis, such as examining the impacts of regional and local oceanography on a factor would likely yield a more accurate assessment of its impact.
5) **Site size and rational for site sizes:** Many sites appeared to be too small. For example, it is likely much more effective to protect the whole West Florida Slope reef complex which runs along a large scarp than a few small research sites within that complex. Related to this, we recommend the rational and consistency for site boundaries as used in this project be re-examined.
6) **A table (or multiple tables) of fish and coral species matched to each site** would be very useful but is beyond the scope of this project. Such tables would allow a better evaluation of biological data quality and consistency, as well as better delineate where data are missing.
7) **Some data in the matrix can be improved**. We recommend an evaluation of the matrix to determine where such improvements are necessary or cost effective.

PLEASE CONTACT US AT:

8502 SW Kansas Avenue
Stuart, FL 34997

+1 (772) 219-3000

csa@conshelf.com

www.csaocean.com

Thank you!

CSA Ocean Sciences Inc.