

Spatial Dynamics of the Quantity and Quality of Natural and Artificial Reef Habitats in the Eastern Gulf of Mexico

Sean Keenan, Ted Switzer, Anthony Knapp, Eric Weather and John Davis
 Florida Fish and Wildlife Conservation Commission (FWC), Fish and Wildlife Research Institute,
 100 8th Ave. SE, St. Petersburg, Florida 33701

Introduction/Background

- Detailed information on reef habitat in the eastern Gulf of Mexico has been limited to localized, well-known reef features, such as the Florida Middle Grounds
- Prior to 2010, fisheries-independent surveys conducted by NMFS were reliant on higher-relief habitats along the shelf break or in shelf waters around Cape San Blas
- In 2010, FWC – Fisheries Independent Monitoring program coordinated with NMFS to implement a standardized, camera-based reef fish survey and used randomized side scan sonar surveys to locate habitat to sample
- Detailed interpretation of side scan data allowed delineation of multiple habitat types and cumulative survey effort generated representative inventory of reef habitats in the eastern Gulf
- Primary objective: Evaluate habitat composition and distribution patterns within the eastern Gulf of Mexico**

Methods

- Sampling universe was created within shelf waters (10 – 180m) in eastern Gulf ranging from the Florida Keys to the Florida-Alabama border
- From this universe, natural or artificial reef grids (0.1 X 0.3nm) were randomly selected to be surveyed (Fig. 1) with a Klein 3900 side-scan sonar system (445 kHz) within depth strata (N = 10-37m; O = 38-110m; D = 111-180m)
- Surveys consisted of north-south (Panhandle) or east-west (Peninsula) passes using the selected grid as a center point (Fig. 1 & 2). Approximately 2.1 sq. km were scanned per survey:
 - Natural** – focused on locating habitat
 - Artificial** – known habitat centered, map adjacent area
- Acoustic data were collected and visualized using Sonar Pro version 12.0® and mosaicked with the most recent version of Chesapeake Technology SonarWiz®
- Habitat classification occurred by trained readers and spatial habitat data were examined in ArcGIS 10.1

Figure 1: Nearshore Panhandle survey area south of Okaloosa/Walton counties showing selected grids. Gray polygons indicate areas surveyed and outline polygons are FWC designated artificial reef areas.

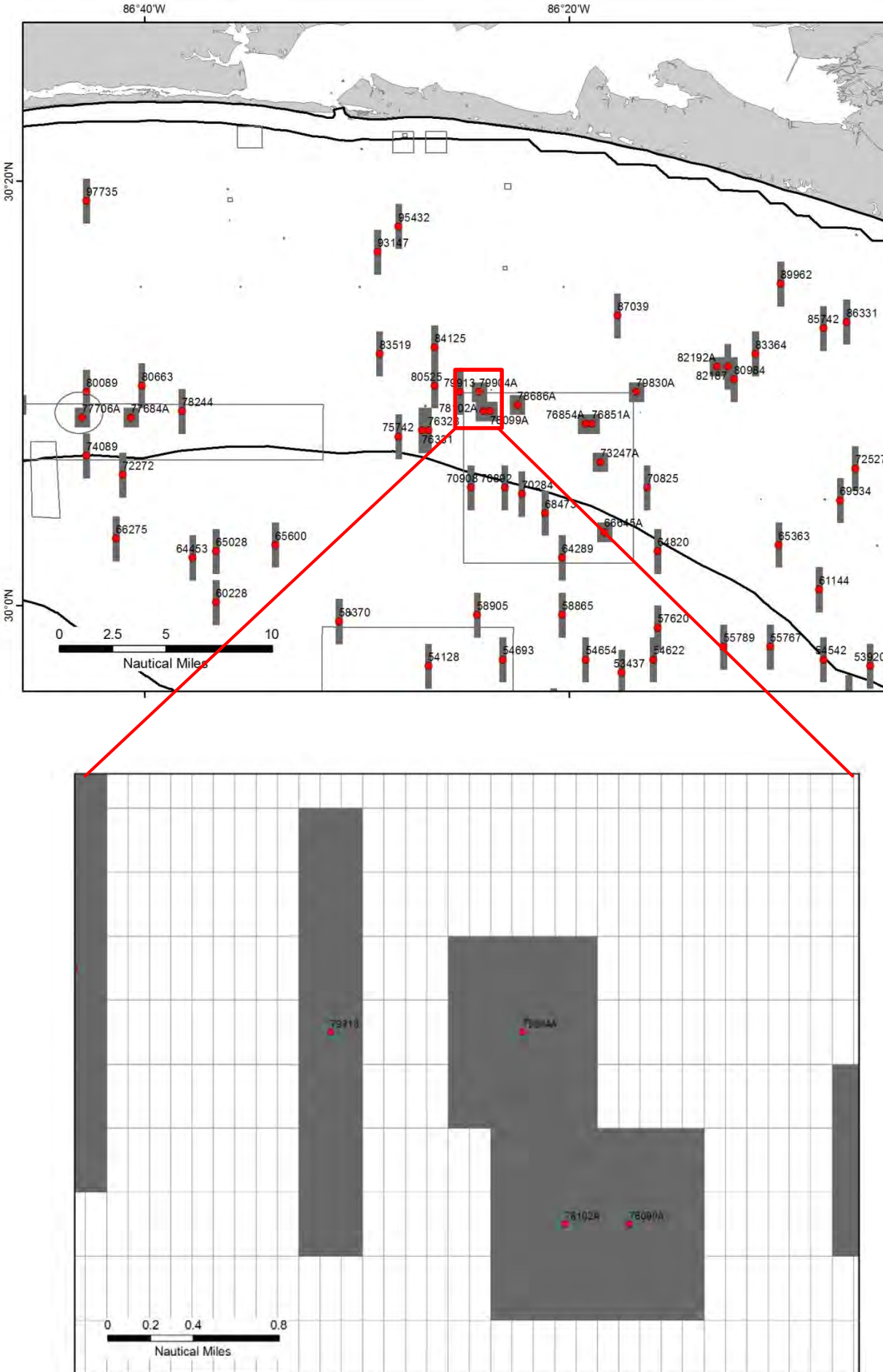


Figure 2: Zoomed in view of four selected sampling surveys: three artificial reef grids (7 x 3 grids) and one natural hard bottom grid (3 x 7 grids). Grid overlay shows the 0.1 x 0.3nm framework where surveys cover a standard area regardless of habitat.



Figure 3: Mosaic for natural reef survey in Fig. 2 (#79913).

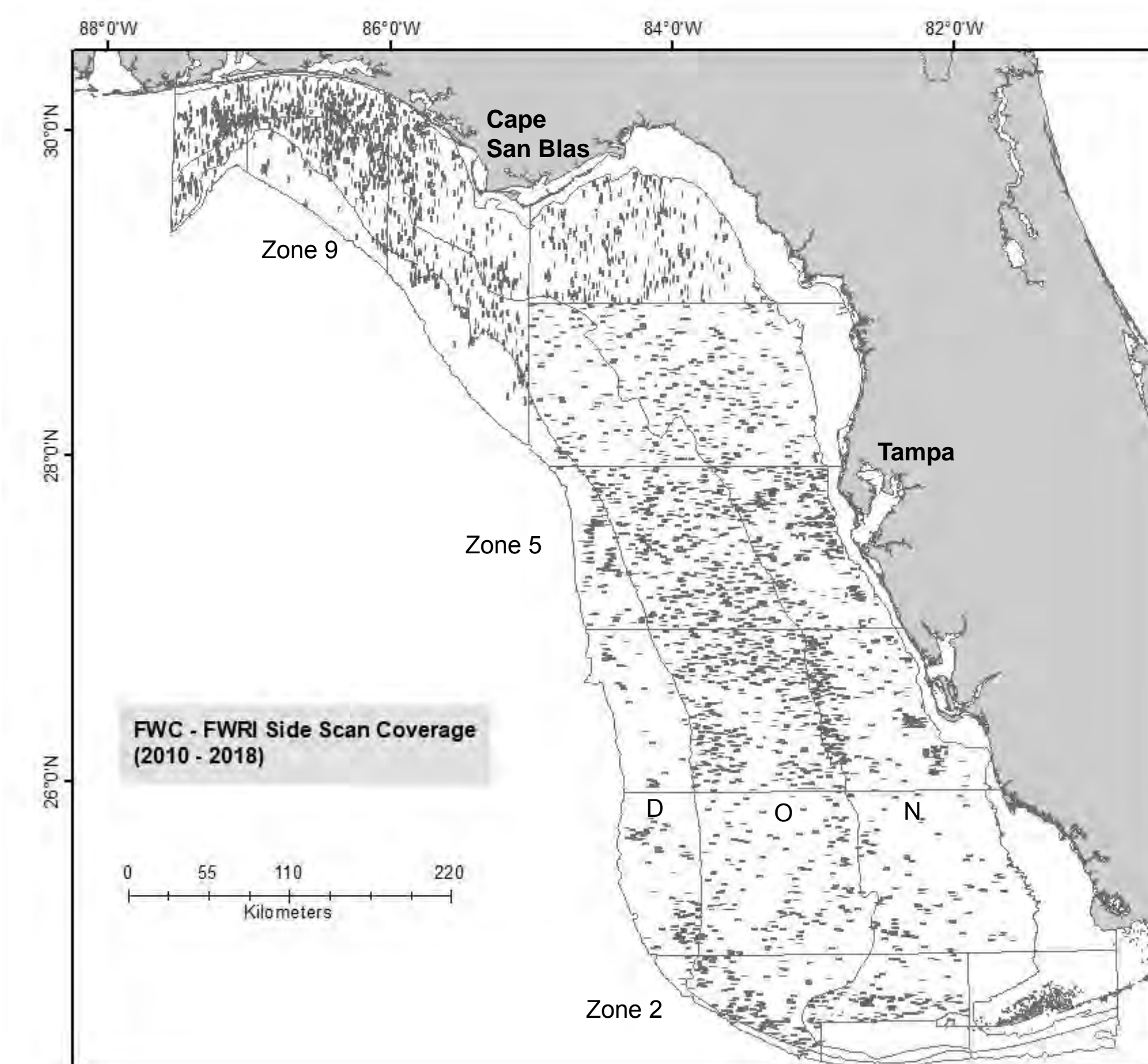


Figure 4. Eastern Gulf of Mexico sampling universe showing NMFS statistical zones and depth (N=10-37m; O=38-110m; D=111-180m) strata. Gray polygons indicate individual side scan sonar surveys conducted between 2010 and 2018 (n = 4,208).

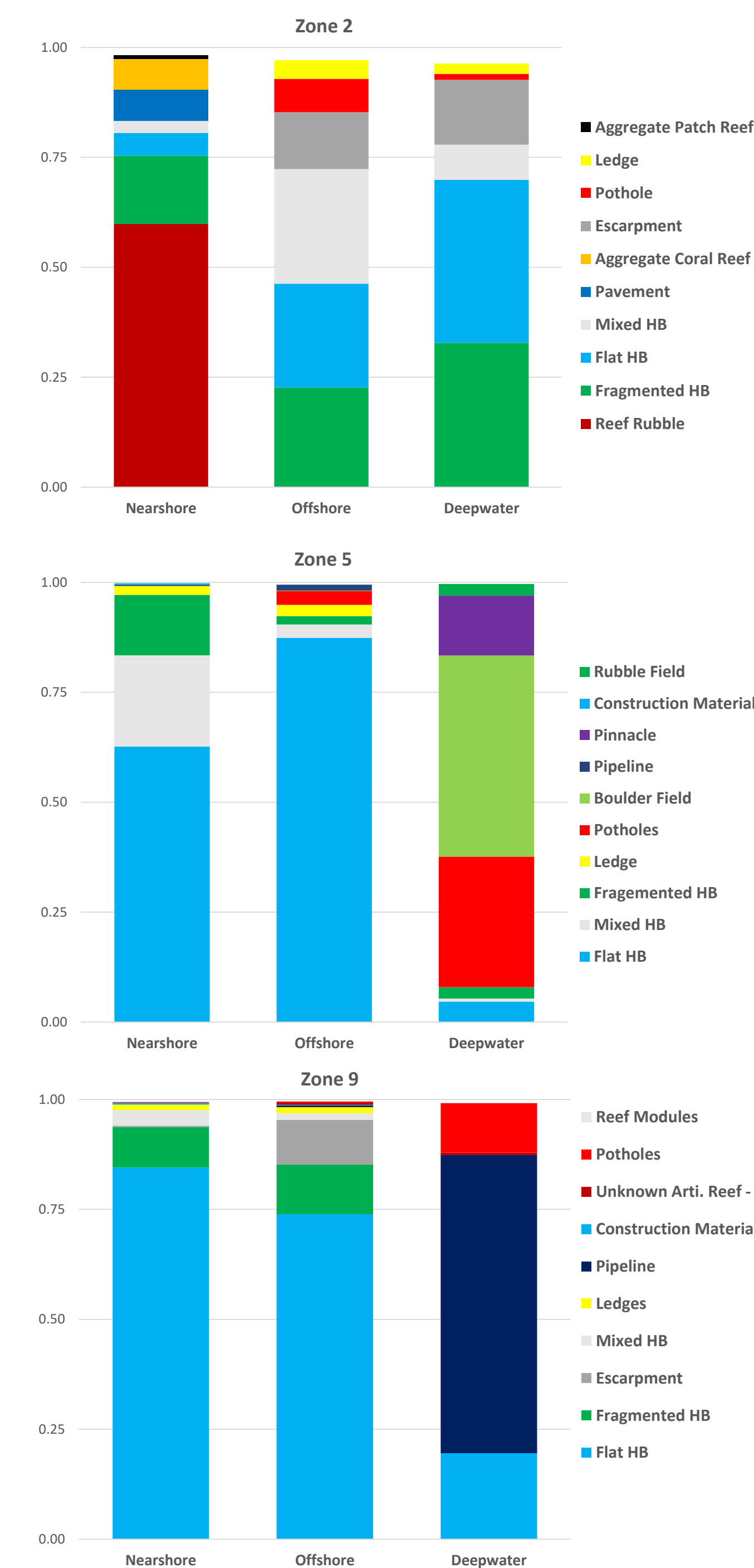


Figure 5. Summary of composition of reef habitat delineated within three example zones. Only top ten habitats ranked by area were represented.

Table 1. Summary of side scan surveys by statistical zone and depth strata (N=10-37m; O=38-110m; D=111-180m) for the 2010 – 2018 habitat data. For each zone * depth strata, total area, area scanned, proportion of the area scanned which was coded as habitat, and extrapolated reef area (Prop. Reef * Total area) was summarized.

Zone	Depth	Total Area (sq. km)	Area Scanned (sq. km)	Prop. Reef Habitat	Est. Total Area Reef (sq. km)
2	N	4,252.69	226.22	0.103	436.43
	O	4,680.04	267.04	0.017	78.88
	D	904.11	26.16	0.009	8.20
3	N	11,558.60	227.72	0.002	28.77
	O	12,358.20	290.74	0.002	19.05
	D	5,553.79	167.30	0.005	30.04
4	N	9,020.47	568.09	0.013	121.02
	O	10,598.08	729.49	0.008	82.10
	D	5,489.74	71.11	0.004	21.82
5	N	7,393.14	614.09	0.076	561.41
	O	10,278.89	785.52	0.016	161.16
	D	3,506.14	163.50	0.013	47.27
6	N	13,373.89	433.59	0.052	700.76
	O	7,040.88	181.99	0.013	91.48
	D	627.38	19.96	0.002	1.25
7	N	11,300.08	498.19	0.063	714.19
	O	5,800.98	456.00	0.011	61.08
	D	4,176.92	105.05	0.002	8.23
8	N	2,965.37	458.54	0.021	61.39
	O	3,316.42	441.02	0.010	31.57
	D	2,759.29	80.39	0.001	2.92
9	N	2,118.26	350.26	0.002	3.20
	O	1,072.58	127.22	0.078	83.93
	D	452.54	11.89	0.001	0.41
Total		144,403.27	7,528.16		3,474.29

Results

- Between 2010 and 2018, 4,208 surveys were completed in the eastern Gulf shelf. Of these, 3,928 surveys were conducted on natural reef habitat and 280 on artificial reef habitat (Fig. 4)
- Over 7,500 sq. km scanned encompasses over 5% of the total area
- Side scan imagery was classified into 43 habitat classes: 25 natural habitats, 17 artificial reef habitats and 1 unconsolidated sediment
- Unconsolidated sediment comprised over 97% of scanned area however reef habitats were identified within every zone and depth strata
- Flat Hardbottom reef habitat dominated all classified habitats by area but relative composition varied across the region (Fig. 5)
- Artificial reef habitats comprised 7.8% of identified reef area and were most prevalent in the Florida Panhandle (Fig. 6)

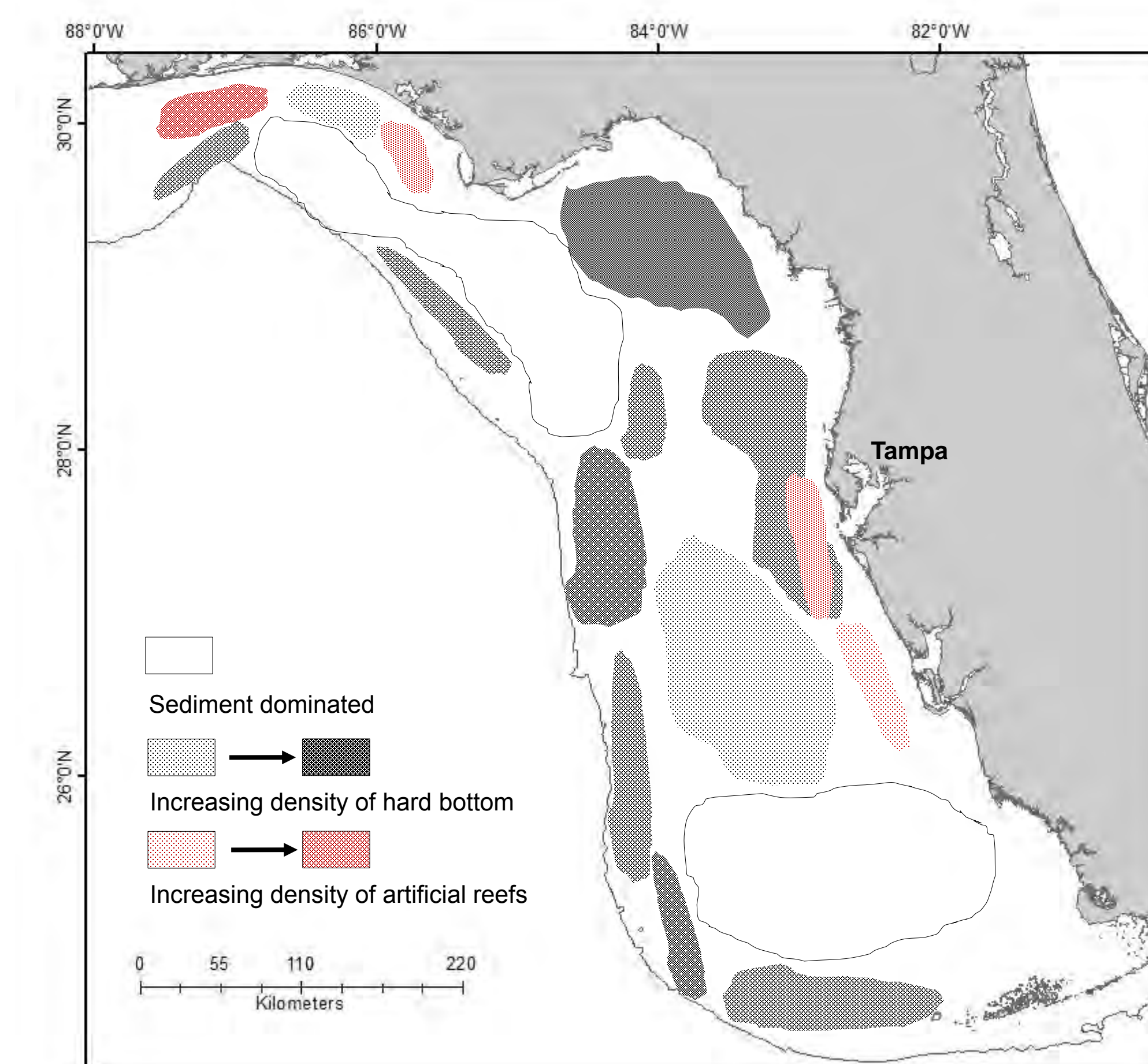


Figure 6. Author's interpretation of habitat distribution in the eastern Gulf of Mexico. General habitat patterns derived through interpretation of side-scan classified habitats including areas of unconsolidated sediment.

Discussion

- Standardized, randomly-selected side scan sonar surveys were successful in identifying numerous artificial and natural reef habitats within shelf-waters of the eastern Gulf of Mexico
- Side scan surveys provide a standardized method to identify small features and provide landscape-level perspective of habitat
- Habitat distribution data inform fisheries-independent surveys: deployment location for camera surveys of reef fish and areas to avoid for groundfish trawl surveys
- Multi-gear, standardized sampling surveys provide the most effective approach to generate species-diverse datasets across wide spatial area, range of depths, and habitats

Acknowledgements

We thank FWC-FWRI personnel for collection and processing of all surveys and data. Funding for this research was made possible through the NFWF - Gulf Environmental Benefit Fund grant #40623

Further Information: Sean.Keenan@myfwc.com