Artificial Structure and Hard-Bottom Spatial Coverage in the Gulf of Mexico

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SEDAR31-DW29

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6/8/12

Artificial Reefs as Essential Fish Habitat Methods

Purpose

This document summarizes the GIS methods used in an April 2012 Gulf of Mexico Fishery Management Council (GMFMC) data compilation and analysis effort that developed estimates of areas covered by known artificial structures in the Gulf of Mexico, as well as one possible estimate of naturally-occurring hard bottom habitat area.

Summary of methods used

The below table and figures were created using data obtained from several sources (listed below) which were reformatted to a standard format and projection and compiled into a single ArcGIS 10.0 geodatabase. Standard ArcGIS 10.0 commands were used to buffer, combine and extract specific geographic areas and perform area calculations. The circular buffer values used were estimated based on an examination of the individual datasets including attributes, general information found online, and discussions among fellow GMFMC staff. An attempt was made to be conservative on the side of overestimating the bottom footprint area of the artificial structure data categories, although area should not be confused with volume and this analysis did not consider volume.

Please note that the University of Colorado INSTAAR 2011 dataset—used as a proxy for naturally-occurring hard-bottom habitat—was the best available dataset from an authoritative source with a Gulf-wide extent and valid metadata. It should be noted, however, that any attempt to accurately quantify all hard-bottom habitat in the Gulf of Mexico will be inherently imperfect and will become quickly outdated by naturally-shifting bottom conditions. Interested parties should investigate the publicly available metadata for this dataset: http://www.ncddc.noaa.gov/website/DataAtlas/Metadata/usSEABED_GOM_sediments.html .

Detailed GIS methods, assumptions and processing notes

Projection used for all analyses: PCS Albers

Data sources & summary information

1) State-permitted artificial reefs

Dataset name: “Compilation of State-permitted artificial reefs as obtained from GSMFC”
Obtained from: Jeff Rester, Gulf States Marine Fisheries Commission, via email 2012-04-02

Location(s):
H:\GIS\PROJECTS\Artificial reefs as EFH\Shapefiles\All_Reefs_Merged
H:\GIS\PROJECTS\Artificial reefs as EFH\ArtReefsAsEFH.mdb\StatePermitted_ArtificialReefs_Buffer4m

Notes:
-This merged shapefile contains georeferenced information on state-permitted, intentionally-sited artificial reef structures from all five Gulf States, as compiled by Jeff Rester for GSMFC purposes.
-Message from Jeff Rester 2012-04-02: “These are the merged files. I kept all the original fields. I got some of these from the state artificial reef coordinators and some directly from their web sites.”
-Each record was buffered using a 4m radius distance.

2) Oil and Gas platforms

Dataset name: “Oil and Gas Platforms in the Gulf of Mexico from BOEM”
Obtained from: http://www.gulfatlas.noaa.gov (accessed April 2012)
Metadata: http://www.ncddc.noaa.gov/website/DataAtlas/Metadata/Platforms.html

Location(s):
H:\GIS\PROJECTS\Artificial reefs as EFH\ArtReefsAsEFH.mdb
\BOEM_Platforms2008_Active_Buffer44m
\BOEM_Platforms2008_Active_Buffer44m_InsideEFH
\BOEM_Platforms2008_Active_Buffer44m_InsideGulfFedEEZ

Notes:
- Starting with the original dataset of 7,020 records in “boem_platform” (C:\DATA\BOEM\8211_OilAndGasStructures\boem_platform), we queried out only the “Active” platforms using the “REMOVAL_DATE” and “REMOVAL” fields. If anything was present in those fields, the records were not exported into the “Active” shapefile. Only 3,701 active platforms remained.
- Buffered using a 44m radius distance.

3) Shipwrecks/Obstructions

Dataset name: “Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS)”
Obtained from: http://www.nauticalcharts.noaa.gov/hsd/AWOIS_download.html (accessed April 2012)
Metadata: http://www.ncddc.noaa.gov/website/DataAtlas/Metadata/awois.html

Location(s):
H:\GIS\PROJECTS\Artificial reefs as EFH\ArtReefsAsEFH.mdb\Shipwrecks_Obstructions_AWOIS_Buffer10m

Notes:
- Buffered using a 10m radius distance.

4) All Artificial Structures combined

Location(s):
H:\GIS\PROJECTS\Artificial reefs as EFH\ArtReefsAsEFH.mdb
\Union_PlatformsReefsWrecks_AllAreas
\Union_PlatformsReefsWrecks_InsideEFH
\Union_PlatformsReefsWrecks_InsideGulfFedEEZ

Notes:
- UNION of the previously-buffered platform, artificial reef, and shipwrecks/obstructions feature classes.

5) Essential Fish Habitat

Dataset name: Essential Fish Habitat shapefiles from NMFS/GMFMC 2004 EFH compilation / contract
Obtained from: MRAG Americas and GIS Solutions

Location(s):
-H:\GIS\PROJECTS\Artificial reefs as EFH\ArtReefsAsEFH.mdb\EFH_6groups_Dissolved

Notes:
- The individual shapefiles for 6 groups not including StoneCrab (CMPs, Coral, RedDrum, ReefFish, Shrimp, SpinyLobster) were UNION'ed and DISSOLVE'ed into a single feature class.

6) Substrate: rock dominant (>66%) and rock subdominant (>33%)

Dataset name: Seafloor Substrates Griddings, Gulf of Mexico
Obtained from: http://www.gulfatlas.noaa.gov (accessed April 2012)
Metadata:
http://www.ncddc.noaa.gov/website/DataAtlas/Metadata/usSEABED_GOM_sediments.html

Location(s):
H:\GIS\PROJECTS\Artificial reefs as EFH\ArtReefsAsEFH.mdb
\Rock_DomSubdom_Dissolved
\Rock_DomSubdom_Dissolved_InsideEFH
\Rock_DomSubdom_Dissolved_InsideGulfFedEEZ

Notes:

- The known field codes ("gom_domnc") for Dominant and Subdominant were used to select and then DISSOLVE into a single polygon feature class with those two components. Areas were calculated separately for each and also combined.

- From metadata: "This is a compilation of diverse data sets, describing the nature of seabed materials".

Calculations & assumptions:

We determined the radius buffer distance to use in ArcGIS using the following assumptions and calculations and using the formula Area=pi(r^2) to determine the buffer radius distance to use.

- For oil and gas platforms, we assumed a circular footprint area of 5,987 m by averaging the estimates from the two literature references (Gallaway 1980 and Shinn 1974). Area= π *(r^2), 5987 = π *$(43.56)^2$, so r=~44. So we used a buffer **radius** distance of 44m for each platform.

- For artificial reefs, from the online sources available and the attributes of records with material type descriptions, many of them are no more than about 50 m^2 (many are less, but we're being conservative), so we used a buffer **radius** distance of 4m (50/ π = 16, $\sqrt{sqrt(16)}$ = 4).

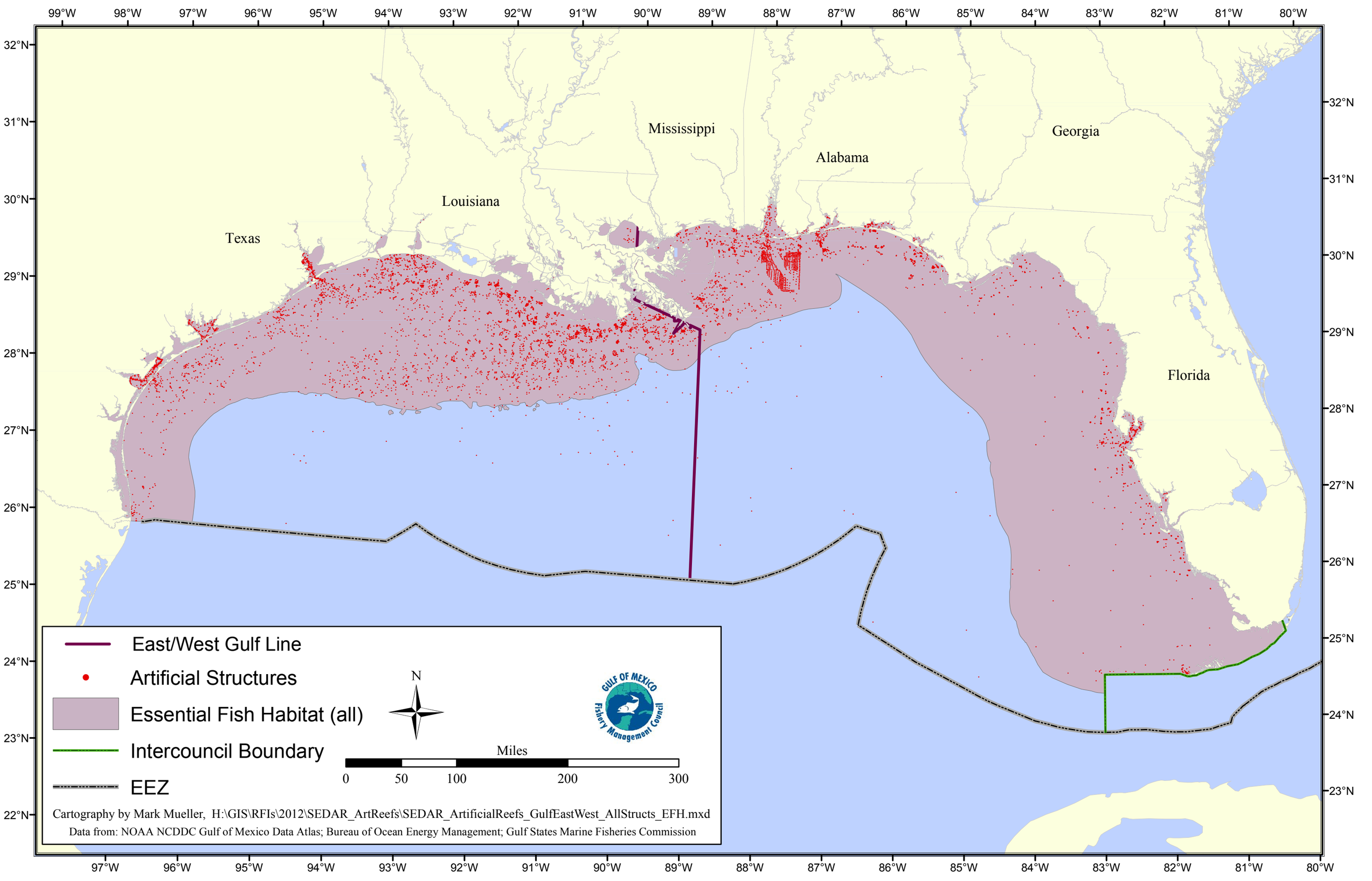
- For shipwrecks, there is a lot of variability, but based on online sources, reasonable mean dimensions might be somewhere around 10x30 m, so we used a buffer **radius** distance of 10m (300/π = 96, $\sqrt{sqrt(96)}$ = 9.8).

- Buffer tool used these settings: "FULL" side type, "ROUND" end type, "ALL" Dissolve type.

	Category	Area km^2	Area Acres
	GULF-WIDE (Shoreline to 200nmi EEZ boundary; both WEST & EAST)		
	Essential Fish Habitat (all GMFMC-managed groups)	349,090.52	86,261,804
	Oil & Gas platforms (active)	20.68	5,110
	State-Permitted Artificial Reefs (SPAR)	0.13	32
	Shipwrecks/Obstructions:	0.75	185
	Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	21.56	5,327
	Rock dominant (>66%):	20,622.14	5,095,821
	Rock subdominant (>33%):	7,290.36	1,801,480
	Rock dominant/subdominant:	27,912.50	6,897,301
	GULF WEST (Shoreline to 200nmi EEZ boundary)		
	Oil & Gas platforms (active)	18.58	4,592
	Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	19.05	4,706
	Rock dominant (>66%):	3,098.64	765,687
	Rock subdominant (>33%):	1,122.42	277,354
	Rock dominant/subdominant:	4,221.05	1,043,041
	Sand dominant (>66%)	19,551.63	4,831,295
	Sand subdominant (>33%)	12,892.85	3,185,879
	Sand dominant/subdominant:	32,444.48	8,017,174
	Gravel dominant (>66%)	10,430.57	2,577,441
	Gravel subdominant (>33%)	4,505.39	1,113,302
	Gravel dominant/subdominant:	14,935.96	3,690,743
	GULF EAST (Shoreline to 200nmi EEZ boundary)		
	Oil & Gas platforms (active)	2.09	518
	Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	2.51	621
	Rock dominant (>66%):	17,523.50	4,330,134
	Rock subdominant (>33%):	6,167.94	1,524,126
	Rock dominant/subdominant:	23,691.44	5,854,259
	Sand dominant (>66%)	81,843.90	20,223,987
	Sand subdominant (>33%)	60,777.22	15,018,317
	Sand dominant/subdominant:	142,621.11	35,242,304
	Gravel dominant (>66%)	19,262.34	4,759,808
	Gravel subdominant (>33%)	23,767.18	5,872,974
	Gravel dominant/subdominant:	43,029.51	10,632,782
EFH-only	**GULF WEST EFH-only (Shoreline to EFH boundary)**		
	Oil & Gas platforms (active)	18.28	4,516
	Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	18.74	4,630
	Rock dominant (>66%):	716.06	176,942
	Rock subdominant (>33%):	693.42	171,346
	Rock dominant/subdominant:	1,409.48	348,288
	GULF EAST EFH-only (Shoreline to EFH boundary)		
	Oil & Gas platforms (active)	2.02	498
	Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	2.43	600
	Rock dominant (>66%):	4,837.54	1,195,376
	Rock subdominant (>33%):	5,970.85	1,475,424
	Rock dominant/subdominant:	10,808.39	2,670,800

FEDERAL WATERS

GULF WEST Federal-only (State/Federal boundary to EEZ boundary)		
Oil & Gas platforms (active)	18.15	4,486
Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	18.33	4,530
Rock dominant (>66%):	716.06	176,942
Rock subdominant (>33%):	680.52	168,159
Rock dominant/subdominant:	1,396.58	345,100
GULF EAST Federal-only (State/Federal boundary to EEZ boundary)		
Oil & Gas platforms (active)	2.08	515
Union of All Artificial Structures (Platforms, SPAR, Shipwrecks)	2.24	553
Rock dominant (>66%):	17,046.42	4,212,245
Rock subdominant (>33%):	5,680.72	1,403,732
Rock dominant/subdominant:	22,727.14	5,615,977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East/West Gulf Line
Artificial Structures
Essential Fish Habitat (all)
Intercouncil Boundary
EEZ
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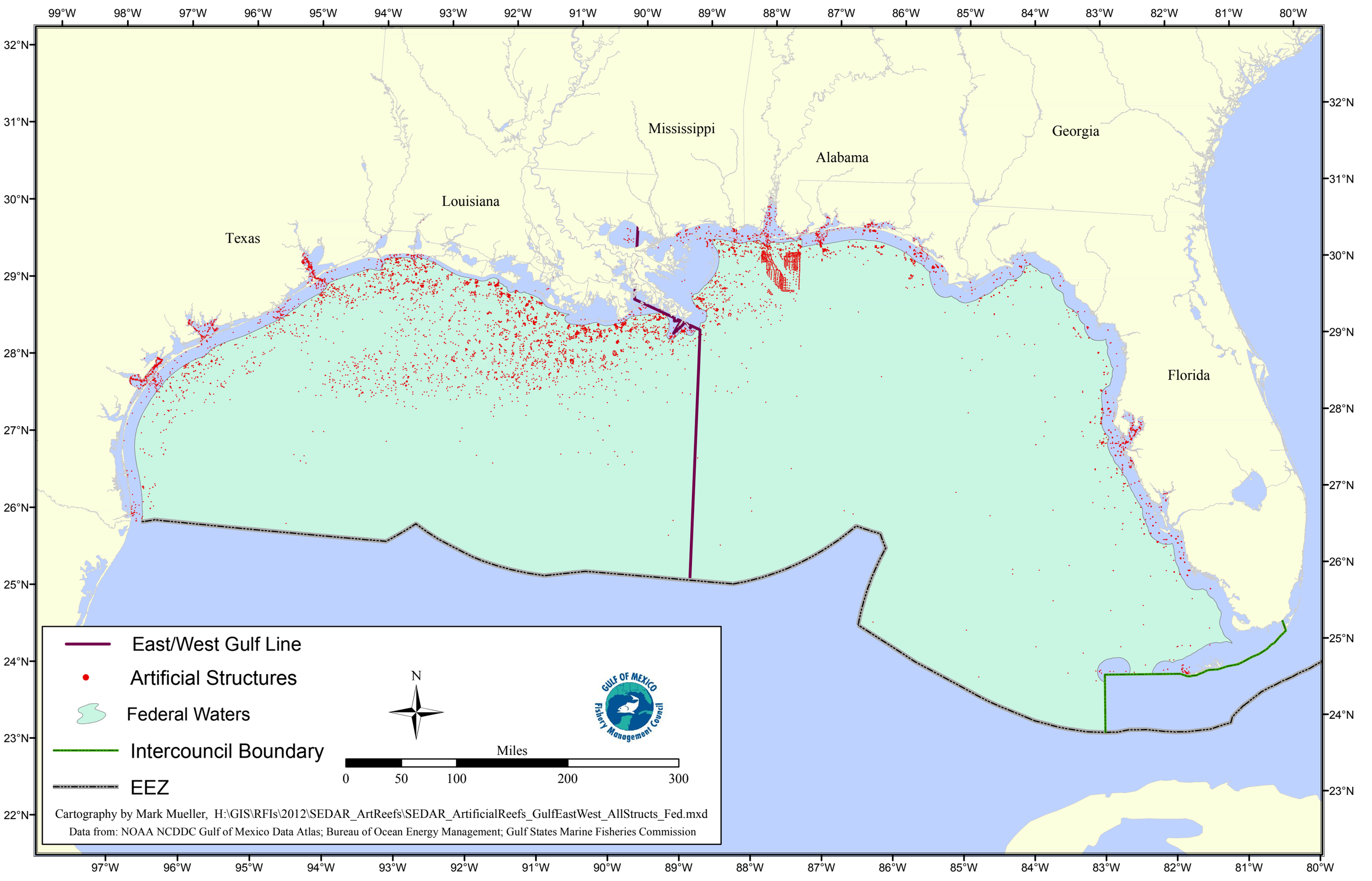
GULF OF MEXICO
Fishery Management Council
Cartography by Mark Mueller, H:\GIS\RFIs\2012\SEDAR_ArtReefs\SEDAR_ArtificialReefs_GulfEastWest_AllStructs_EFH.mxd
Data from: NOAA NCDDC Gulf of Mexico Data Atlas; Bureau of Ocean Energy Management; Gulf States Marine Fisheries Commission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East/West Gulf Line
Artificial Structures
Federal Waters
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GULF OF MEXICO
Fishery Management Council
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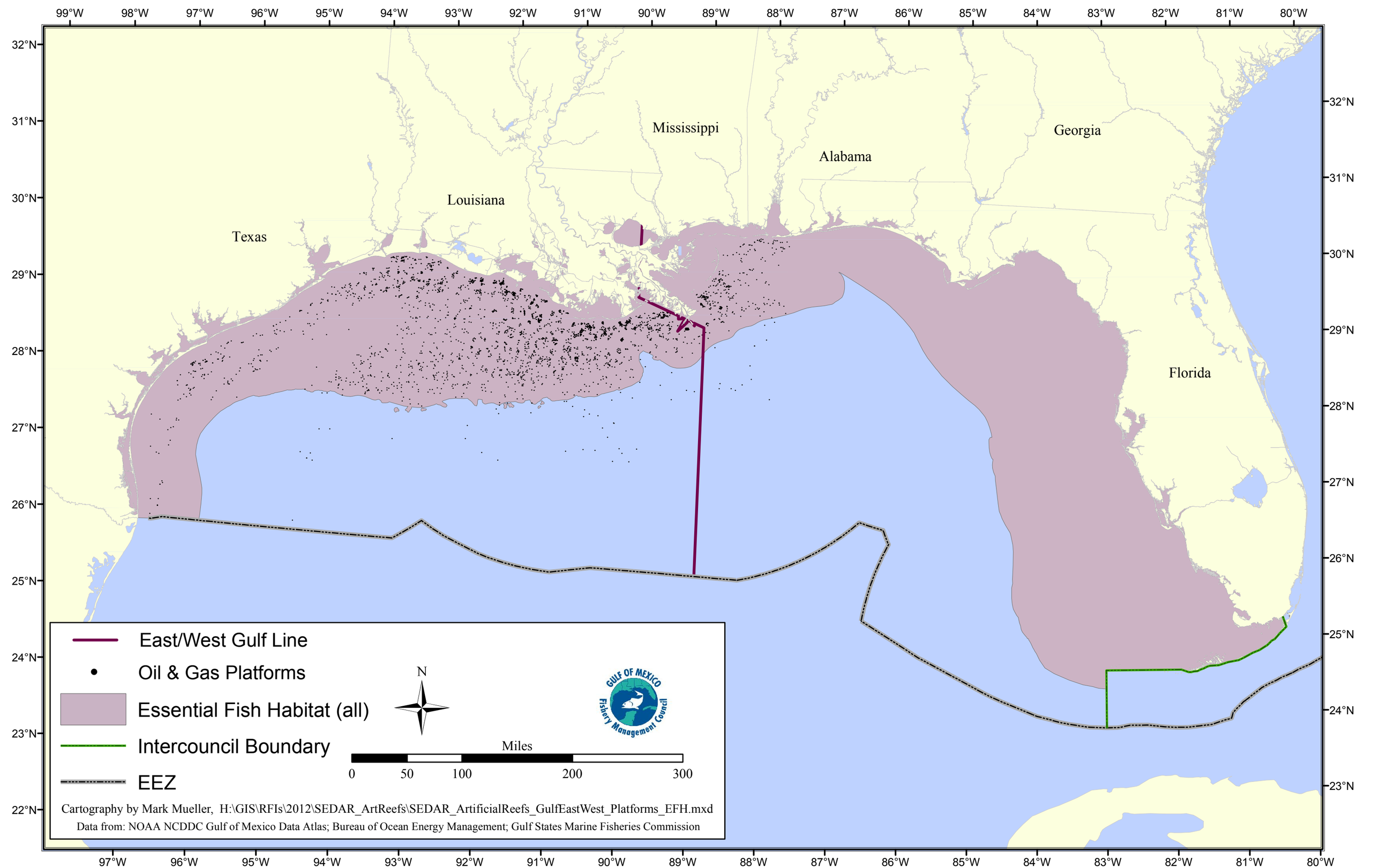
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East/West Gulf Line
Oil & Gas Platforms
Essential Fish Habitat (all)
Intercouncil Boundary
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GULF OF MEXICO
Fishery Management Council
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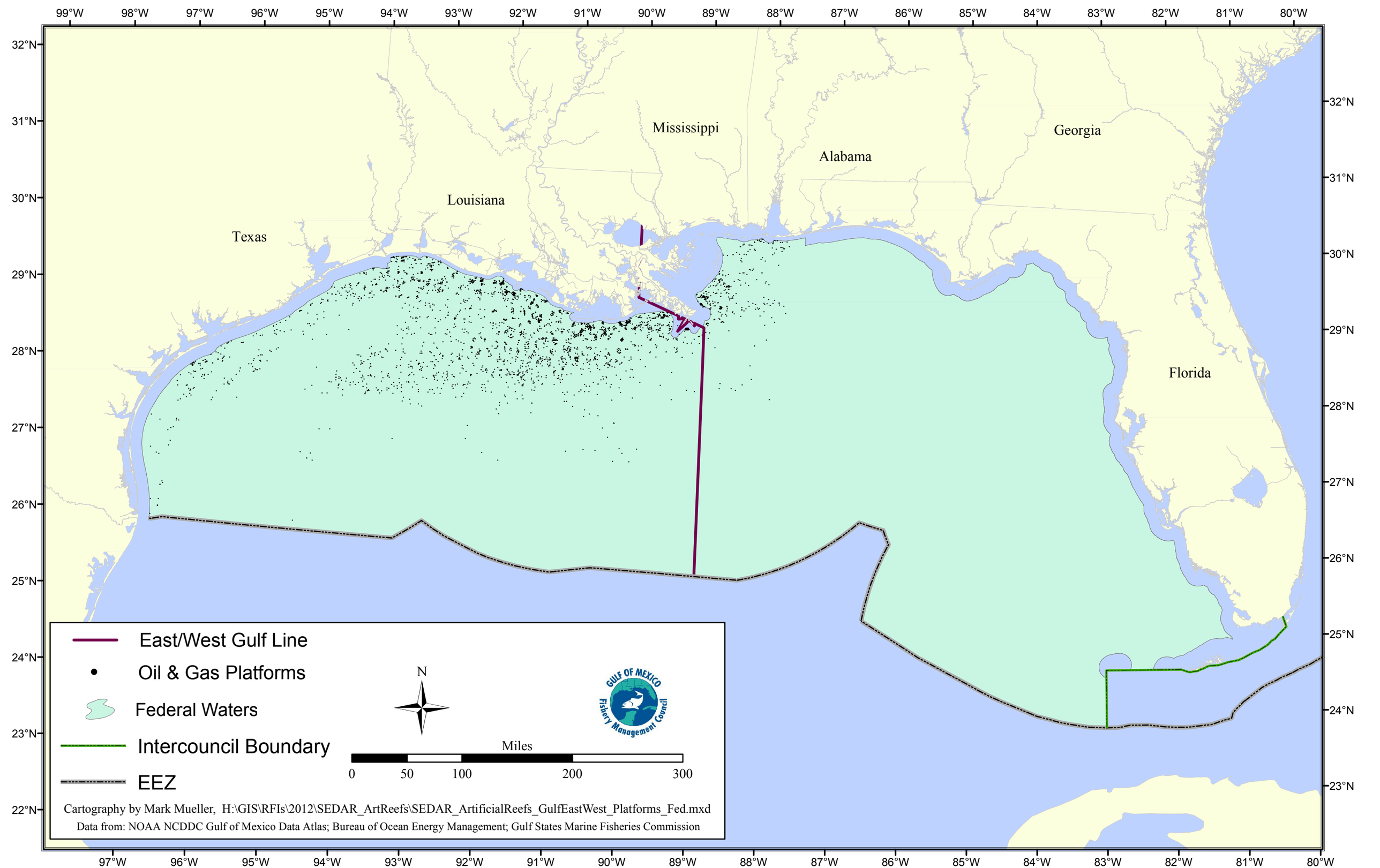
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East/West Gulf Line
Oil & Gas Platforms
Federal Waters
Intercouncil Boundary
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GULF OF MEXICO
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Texas
Louisiana
Mississippi
Alabama
Georgia
Florida

Mud (subdom)
Mud (dom)
Sand (subdom)
Sand (dom)
Gravel (subdom)
Gravel (dom)
Rock (subdom)
Rock (dom)

East/West Gulf Line
Intercouncil Boundary
EEZ

N

Miles
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Cartography by Mark Mueller, H:\GIS\RFIs\2012\SEDAR_ArtReefs\SEDAR_ArtificialReefs_GulfEastWest_Sediments.mxd
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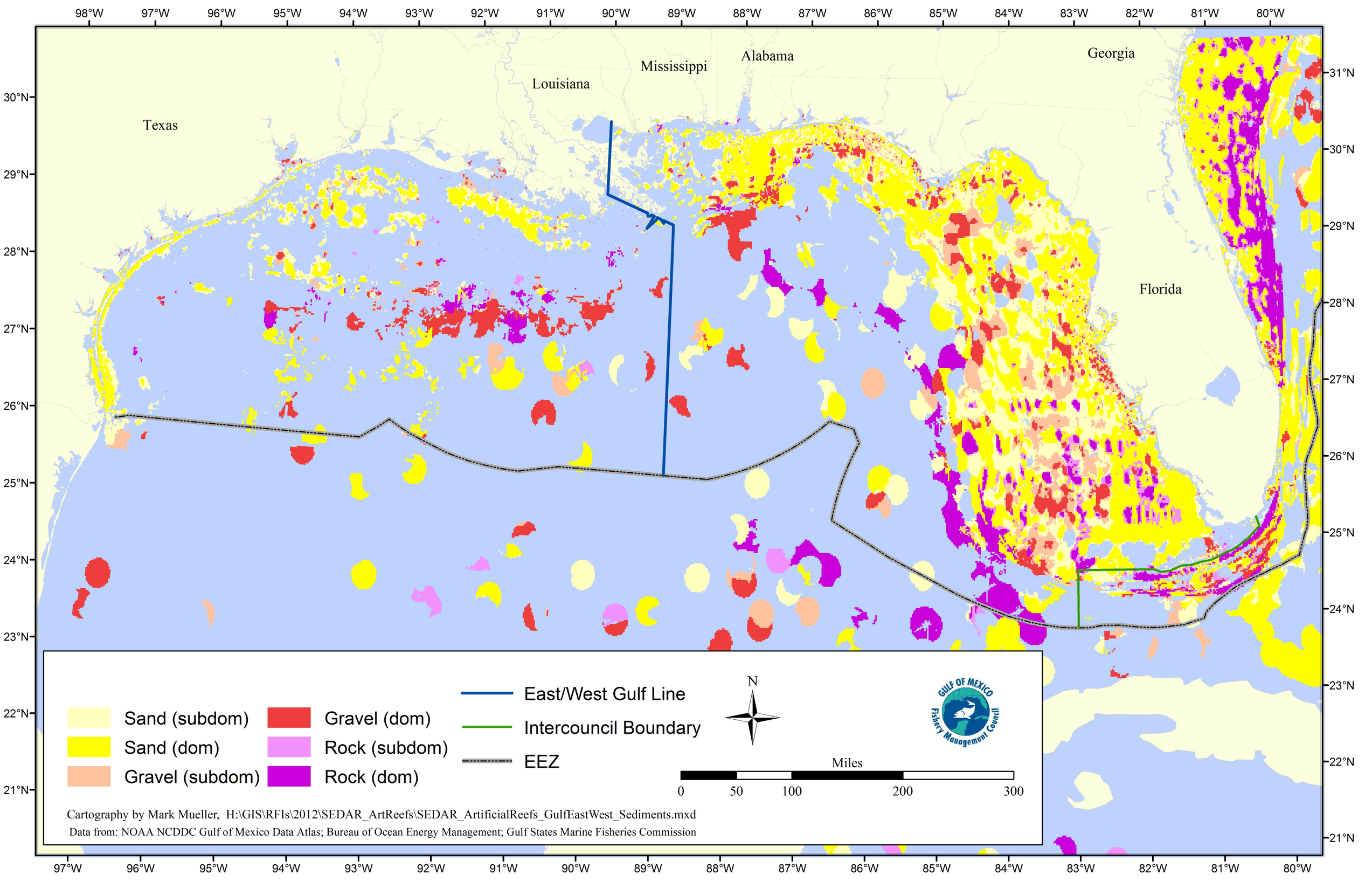
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East/West Gulf Line
Intercouncil Boundary
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GULF OF MEXICO
Fishery Management Council
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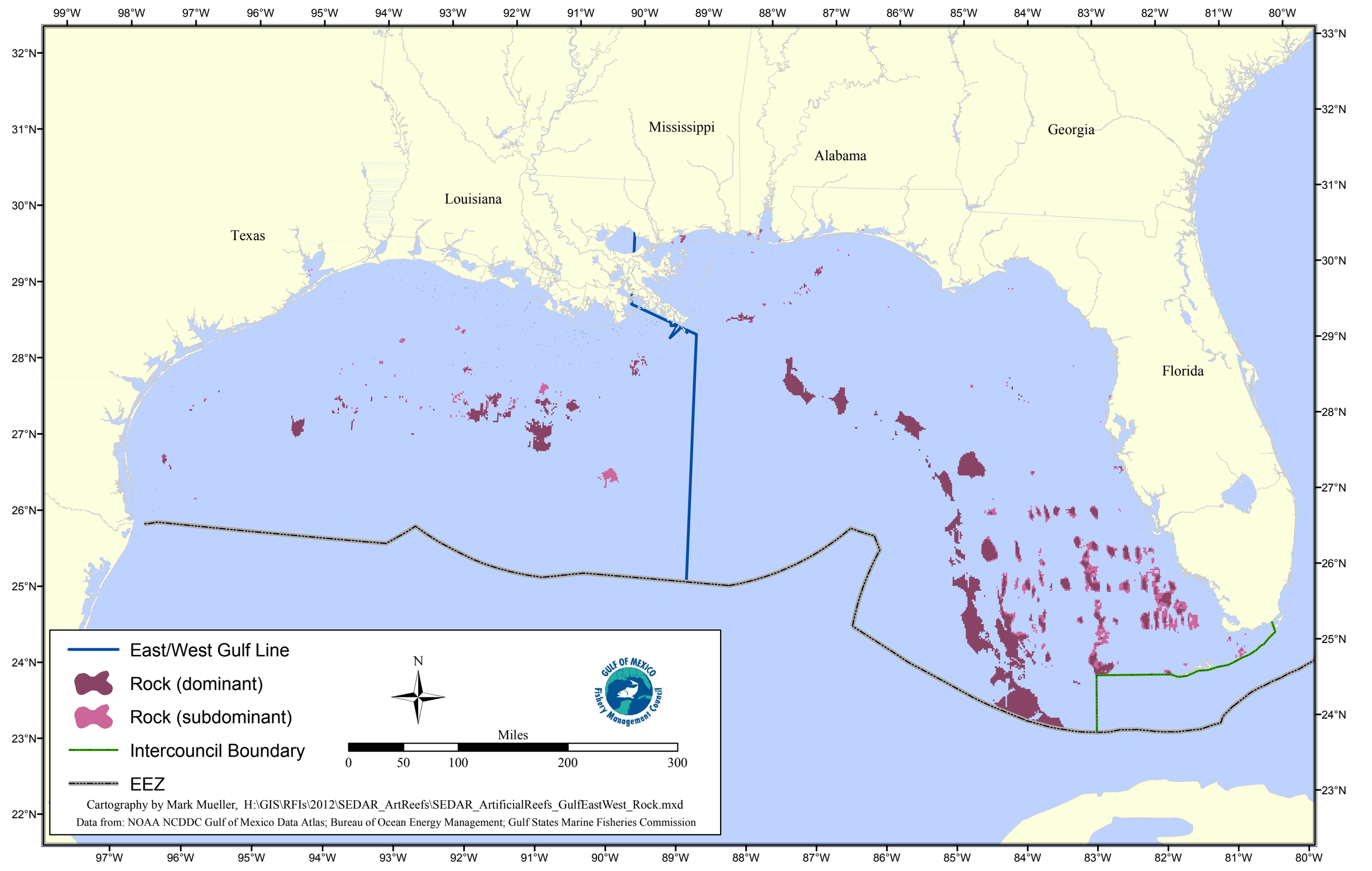
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Alabama
Georgia
Florida
East/West Gulf Line
Rock (dominant)
Rock (subdominant)
Intercouncil Boundary
EEZ
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Miles
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GULF OF MEXICO
Fishery Management Council
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Data from: NOAA NCDDC Gulf of Mexico Data Atlas; Bureau of Ocean Energy Management; Gulf States Marine Fisheries Commission

Texas
Louisiana
Mississippi
Alabama
Georgia
Florida

Gravel (subdominant)
Gravel (dominant)

East/West Gulf Line
Intercouncil Boundary
EEZ

N

Miles
0 50 100 200 300

Cartography by Mark Mueller, H:\GIS\RFIs\2012\SEDAR_ArtReefs\SEDAR_ArtificialReefs_GulfEastWest_Sediments.mxd
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Texas
Louisiana
Mississippi
Alabama
Georgia
Florida

Sand (subdominant)
Sand (dominant)
East/West Gulf Line
Intercouncil Boundary
EEZ

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Miles
0 50 100 200 300

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