NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

Sand Shoals and Fish Habitat Value for Sand Mining and EFH Assessments

shoalMATE

Shoal Map Assessment Tool for EFH

Brad Pickens: CSS-Inc.; Affiliate of NOAA, National Centers for Coastal Ocean Science

Chris Taylor: NOAA, National Centers for Coastal Ocean Science

Mark Finkbeiner: NOAA Office for Coastal Management

Deena Hansen & Lora Turner: Bureau of Ocean Energy Management

Alexa Ramirez & Elizabeth Rogers: Quantum Spatial, Inc.

Project Team

BOEM
Bureau of Ocean Energy Management

NOAA

quantum SPATIAL







Key Partners in Data, Modeling, and Interpretation

NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

- William Driggers III, Matthew Campbell & Nate Bacheler (NMFS Southeast Fisheries Science Center)
- Kevin Friedland (NMFS Northeast Fisheries Science Center)
- Bryan Frazier (South Carolina DNR)
- Rachel Carroll (University of North Carolina Wilmington (UNCW))
- UNCW Center for Marine Science

Outline

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1) Background

2) Modeling of sand shoal distributions

3) Overall findings from species distribution models

4) Findings for South Atlantic fish species distribution models

5) Introduction to ShoalMATE geospatial tool

shoalMATE
Shoal Map Assessment Tool for EFH

Demand for Marine Sand

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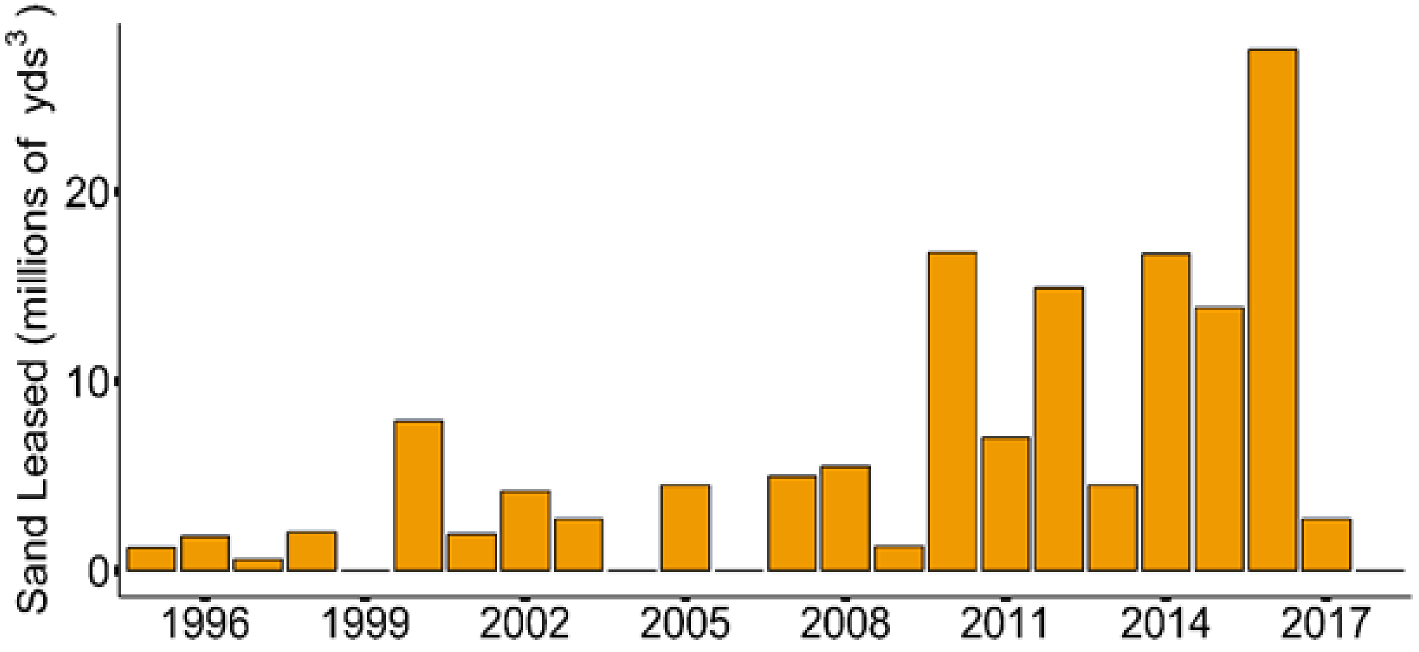
- Marine sands are used for beach renourishment and barrier island restoration

- Demand for offshore sand has increased rapidly with depletion of nearshore sand resources
  - Storms, erosion
  - Coastal infrastructure & tourism ($$$)



Sand Shoals & Fish

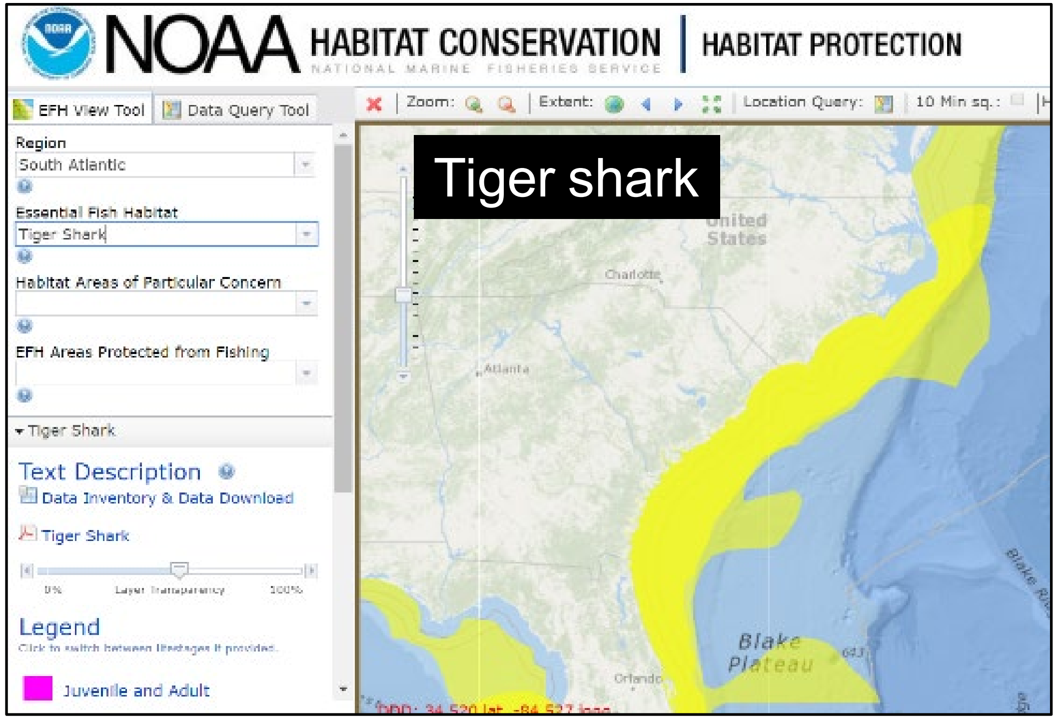
Dredging of sand shoals is the most efficient method to obtain marine sands

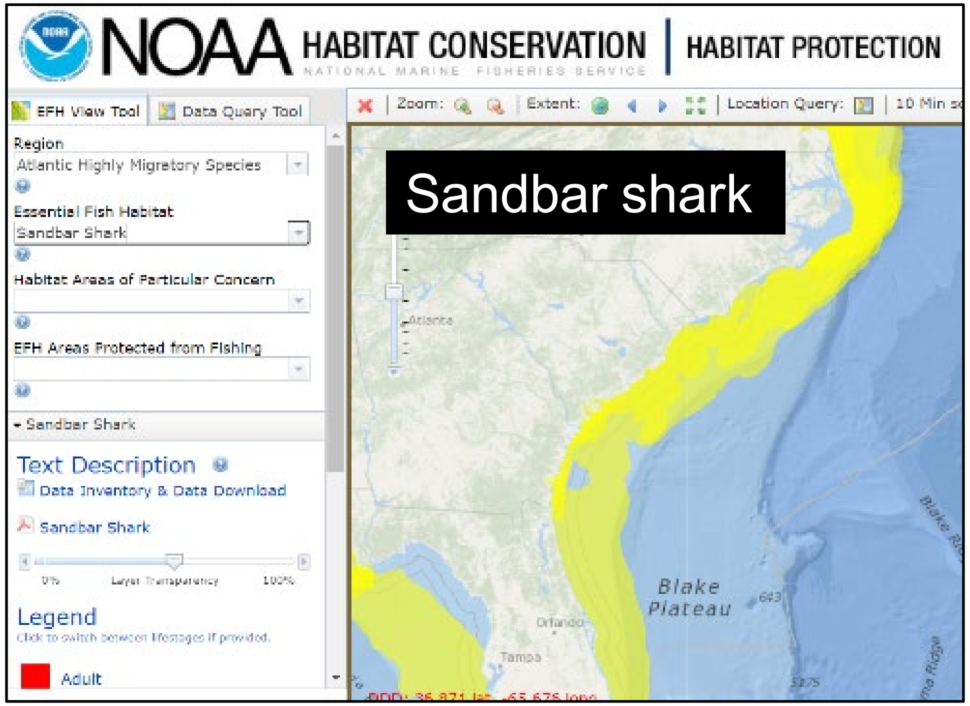
- Sand shoals are often designated as ‘Essential Fish Habitat’, but extent of shoals are largely unknown
- Essential Fish Habitat consultation is required for sand dredging, yet little is known about shoal habitat value to fish
- Consistent and science-based assessment of fish habitat value is needed to implement a more strategic approach

Frying Pan Shoals, North Carolina

Essential Fish Habitat (EFH)

- EFH designations allow for protection of fish habitats
- However, EFH often does not provide fine-scale detail necessary to make local decisions





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Understanding BOEM and NMFS Requirements

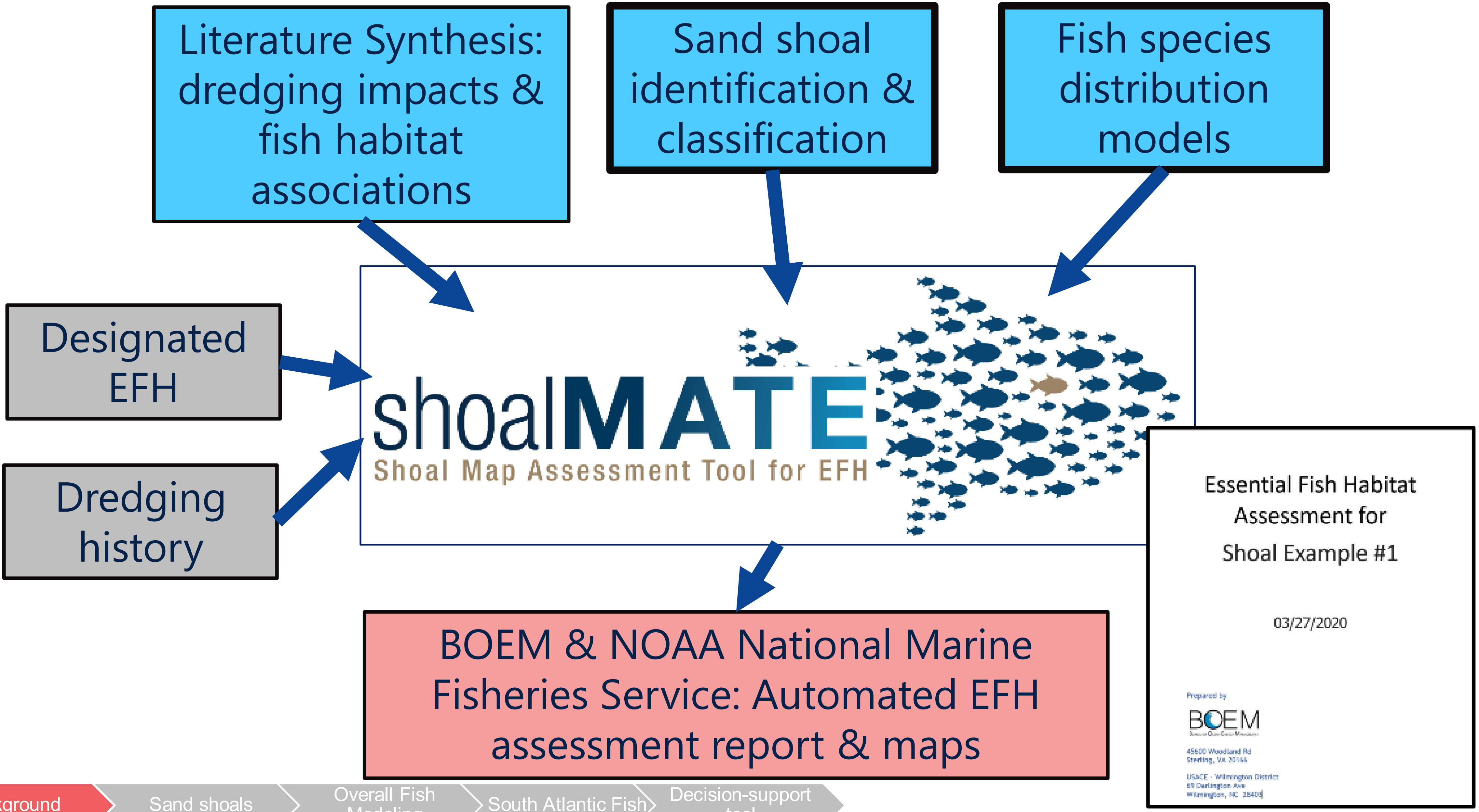
BOEM

- Shoal classification scheme
- Citable reports and syntheses
- Peer-reviewed manuscripts
- Consistent format and content in EFH Assessments
- Interactive “map tool” and unified geodatabase

NMFS

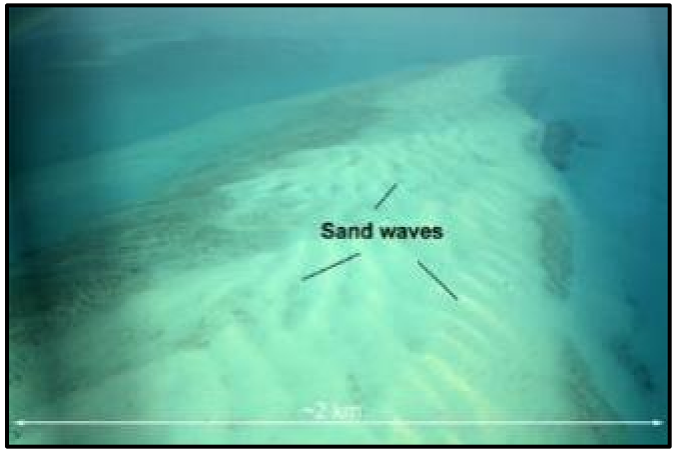
- Citable reports and syntheses
- Peer-reviewed manuscripts
- Consistent format and content in EFH Assessments

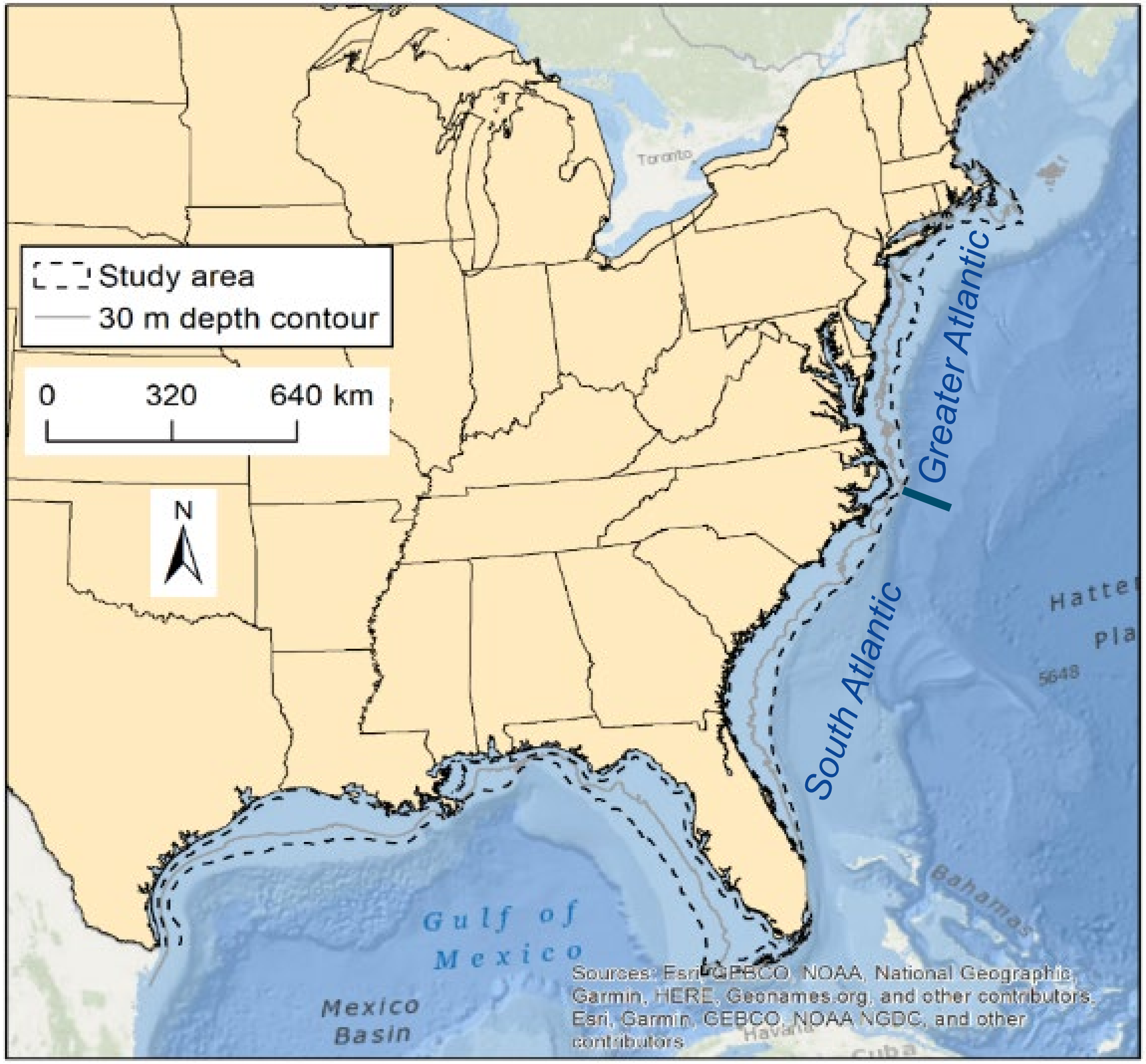
Framework of Study



Study Area

- Extent of Atlantic & Gulf of Mexico coasts where relevant to dredging
- Restricted to offshore, <u>federally managed</u> waters of ≤ 50 m depth





Sand Shoal Identification & Classification

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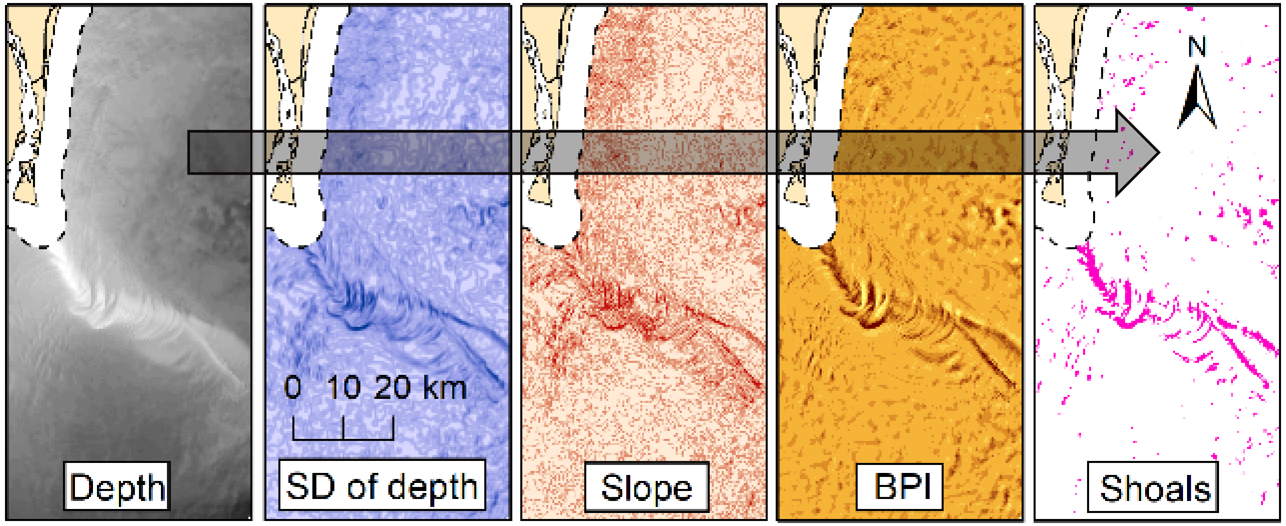
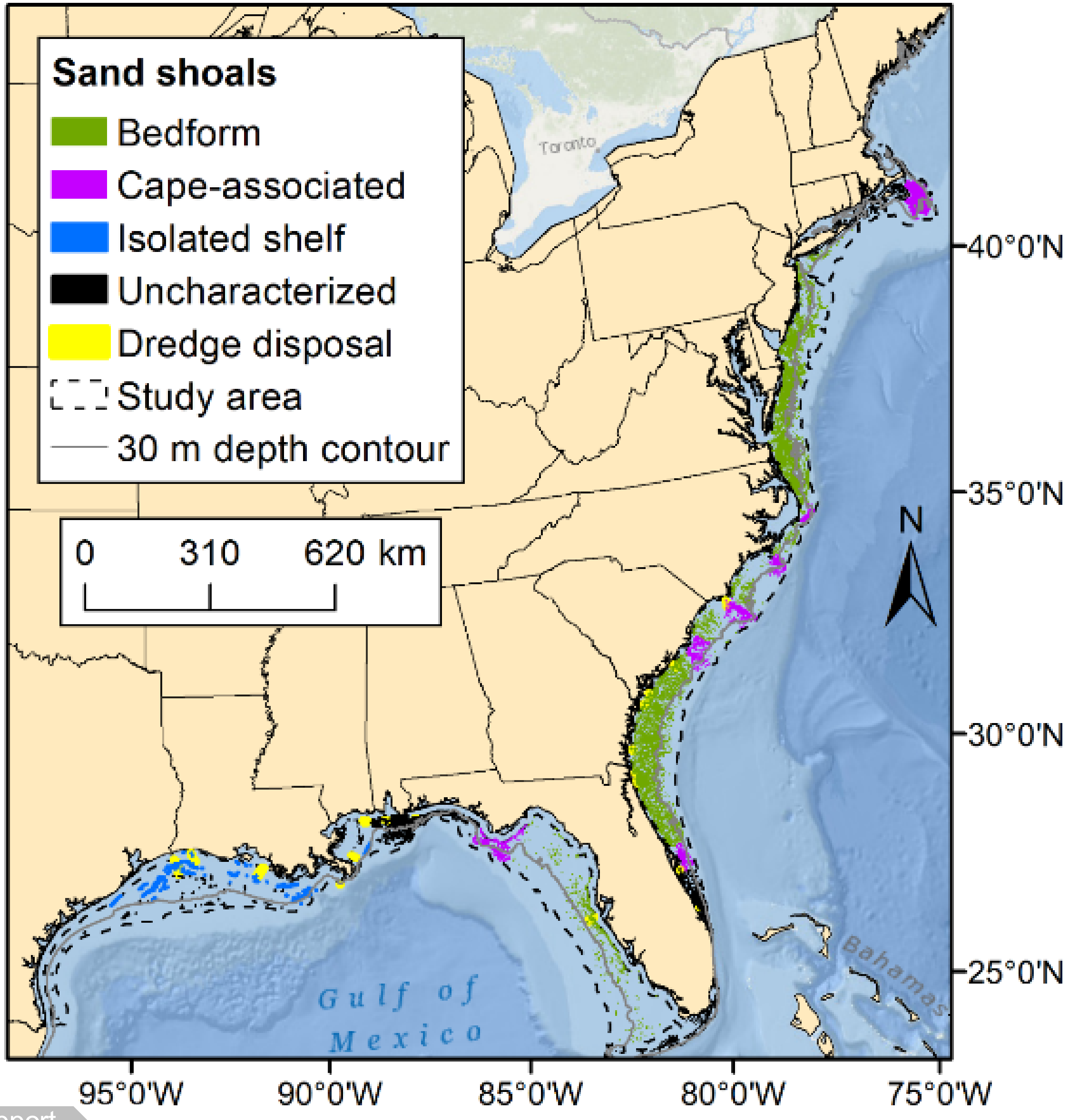
- Conducted a seafloor classification using distance to shore & geomorphology metrics





Verification of Sand Shoals

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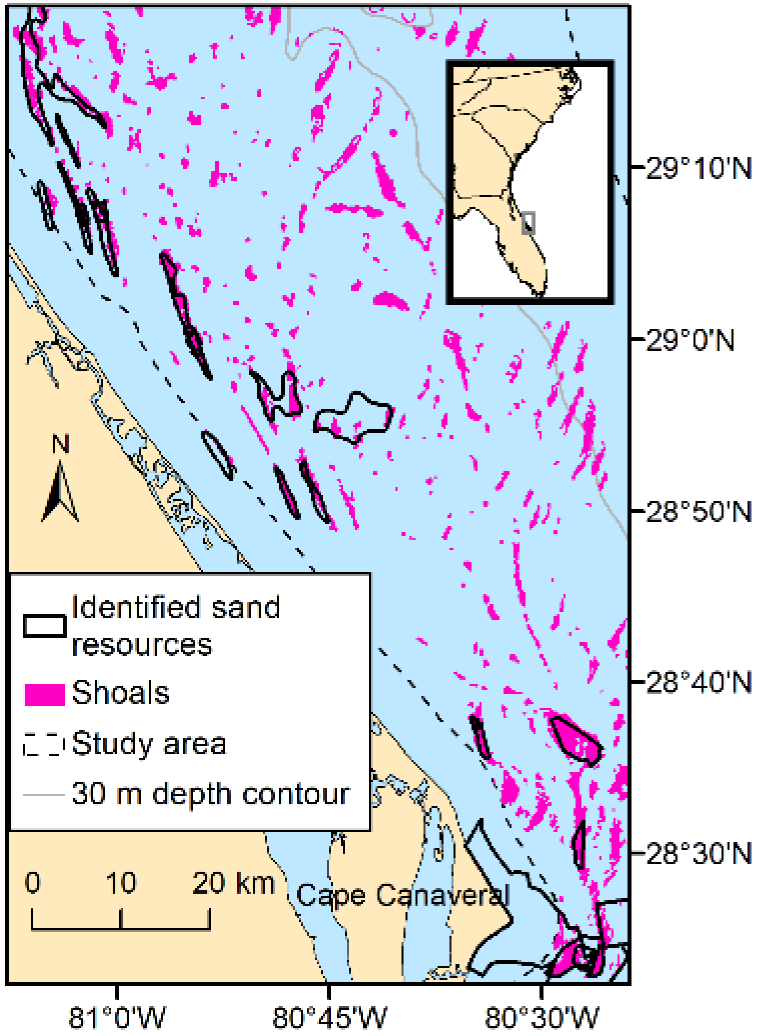
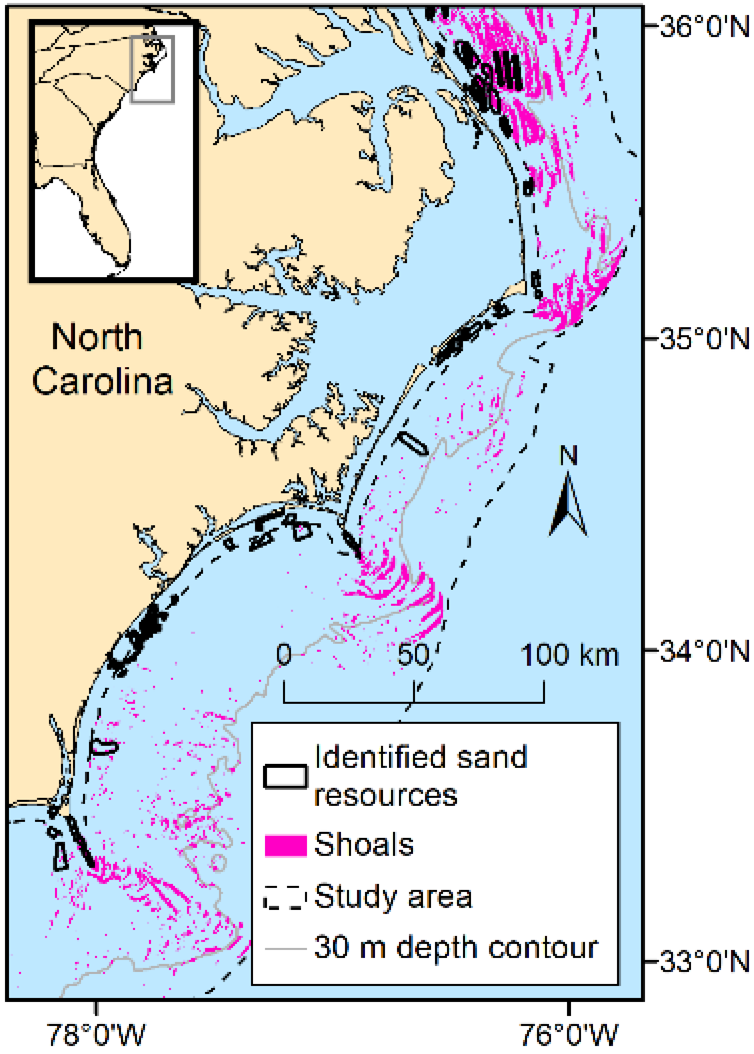
- Classified shoals visually & quantitatively matched well with "identified sand resources" mapped by BOEM
- Available on BOEM's MMIS online viewer
- *In press,* Journal of Coastal Research

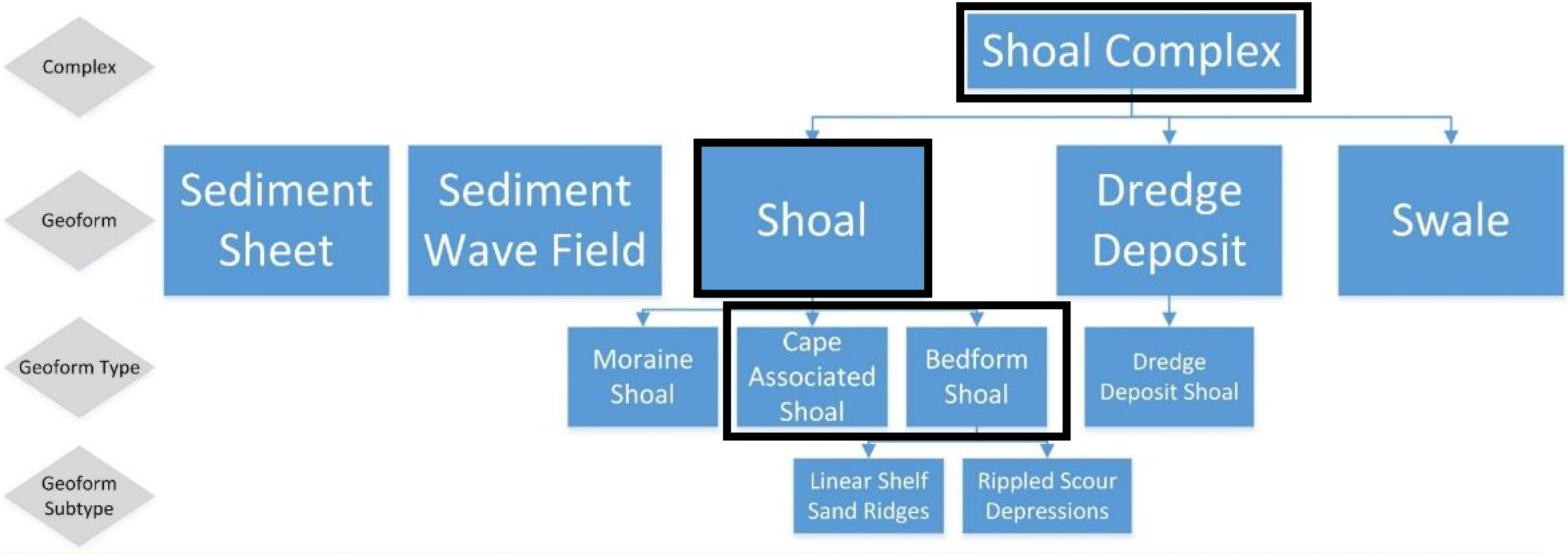




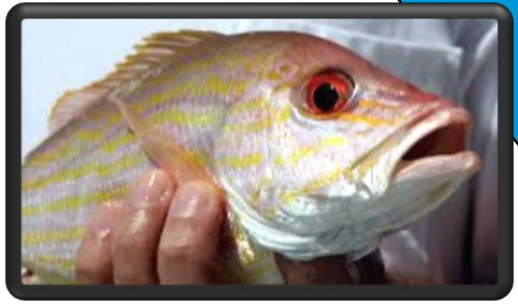
Coastal & Marine Ecological Classification Standard (CMECS)

NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

- Classification scheme developed from expert opinion and workshops to describe shoals in relation to fish and dredging



Species Selected for Habitat Modeling



- Designated with EFH?
- Documented using shoals?
- Data available? (esp. South Atlantic)
- Vulnerable to dredging? (demersal)
- Economic importance

Species Selected for Habitat Modeling

- Gulf of Mexico: 8 species, including Penaeid shrimp, juvenile red & lane snapper, blacktip shark, spinner shark, Atlantic sharpnose shark

- Greater Atlantic: 34 species from trawl surveys (modeled by Dr. Kevin Friedland, NMFS NEFSC)

- South Atlantic: Red snapper, black sea bass, tiger shark, sandbar shark, blacknose shark

Species Distribution Modeling

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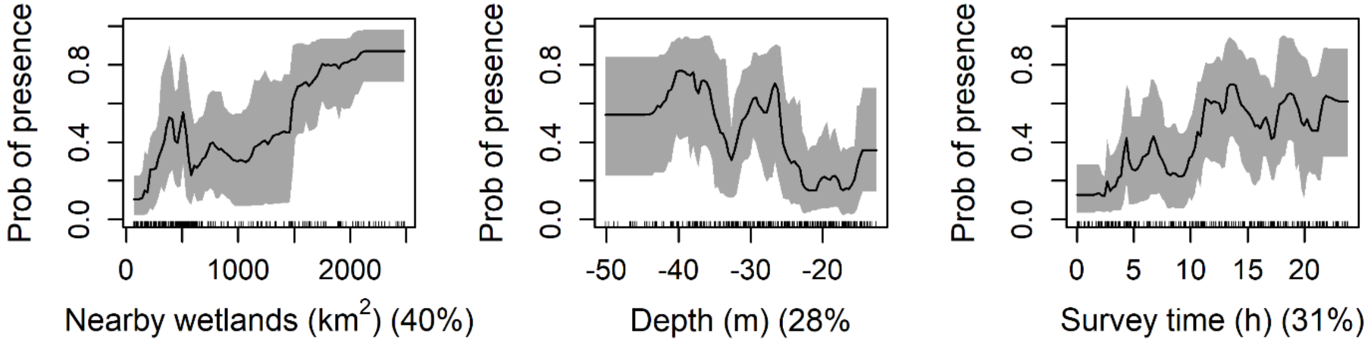
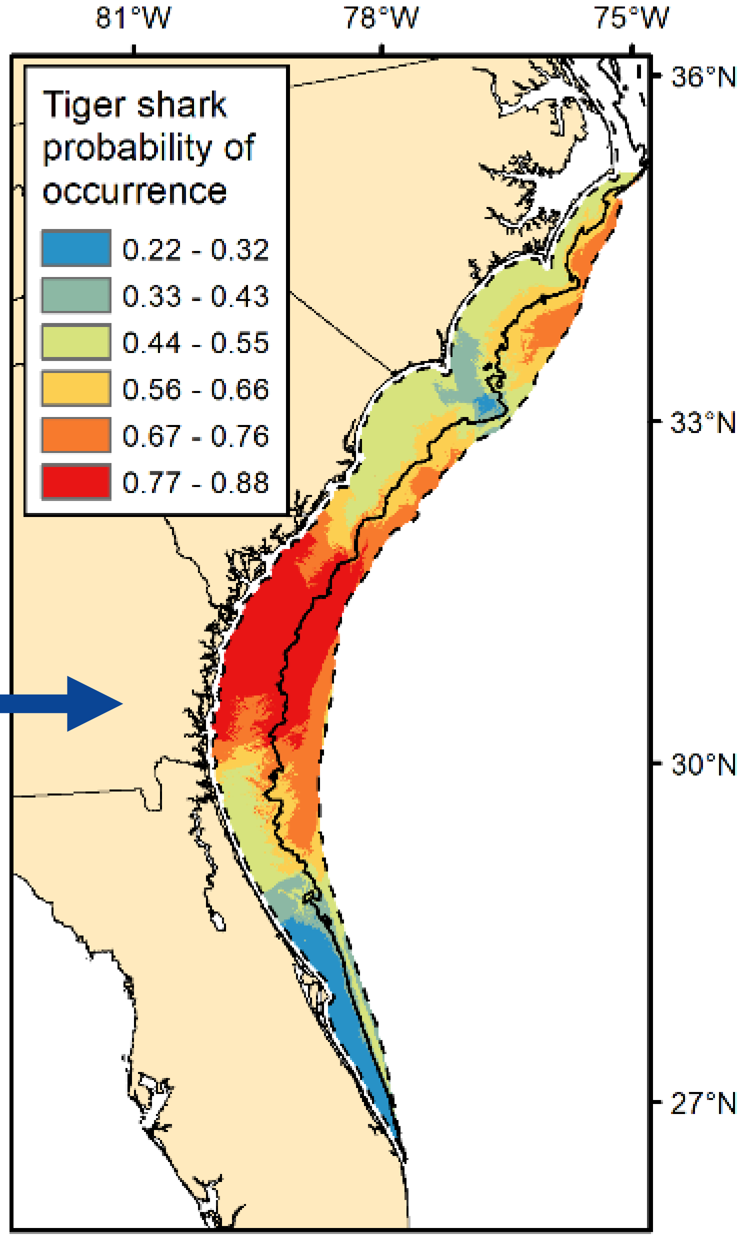
Data sources: Fishery-independent surveys
- Trawl, trap, video, and longline

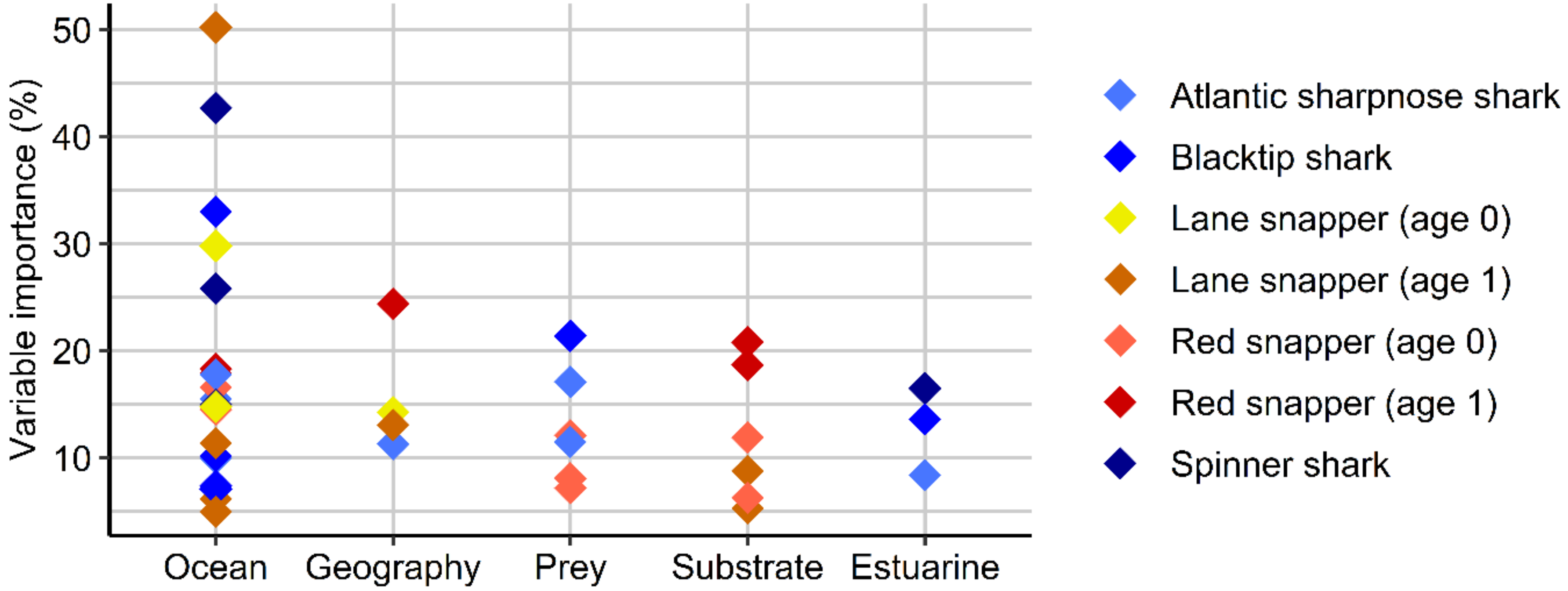
34 habitat predictors





Overall Gulf of Mexico Findings

- **Oceanographic factors** were frequent predictors of fish & were most important (*e.g.*,mixed layer depth, salinity)
- **Prey species** were correlated with snappers & sharks
- **Substrate of minor importance** for snappers, nearby wetlands/estuaries selected by sharks



Nearby Wetlands

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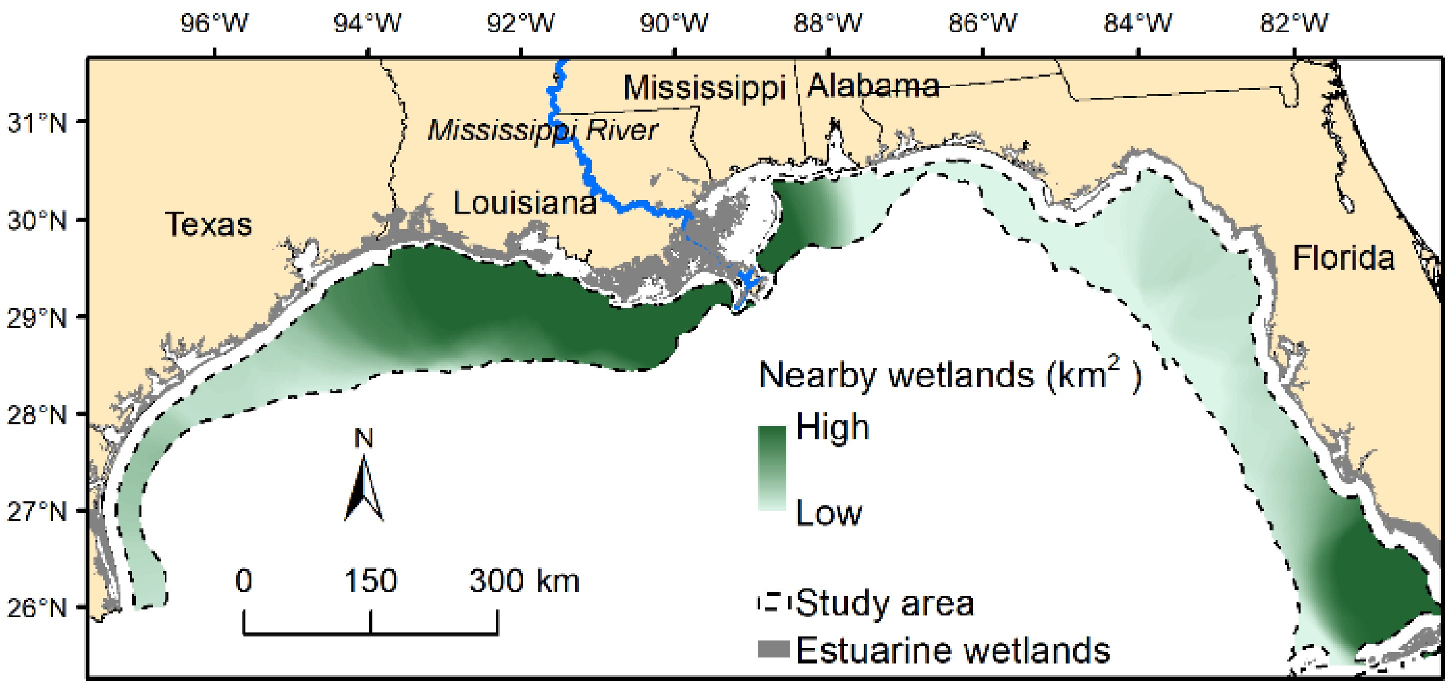
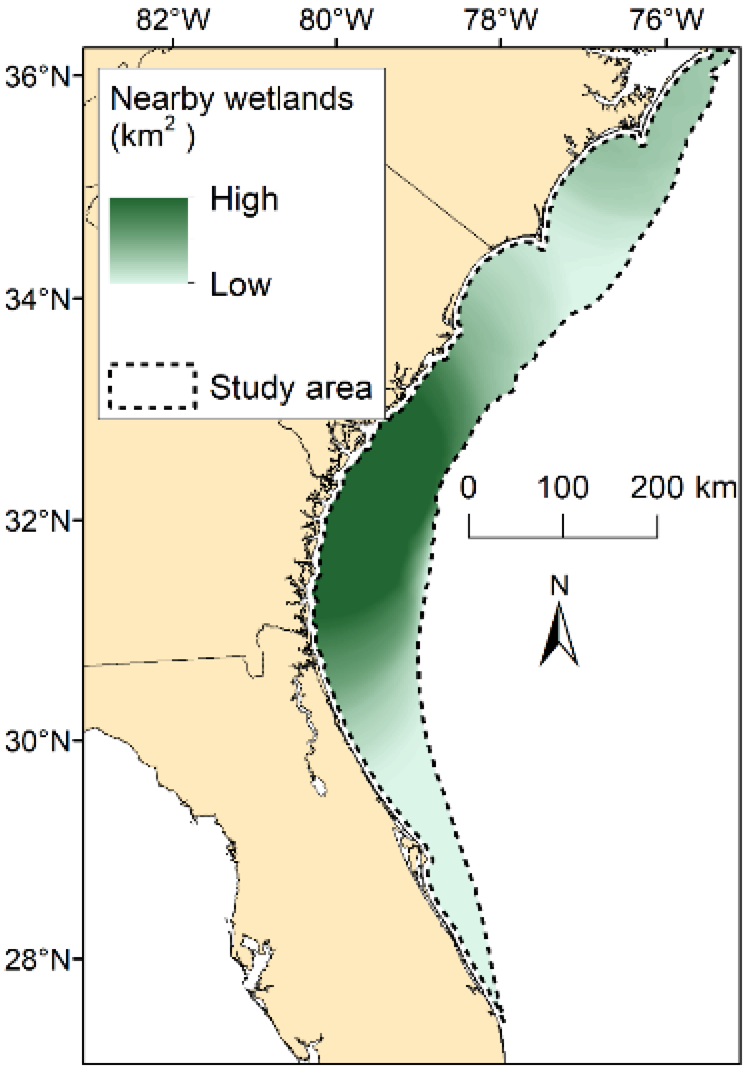
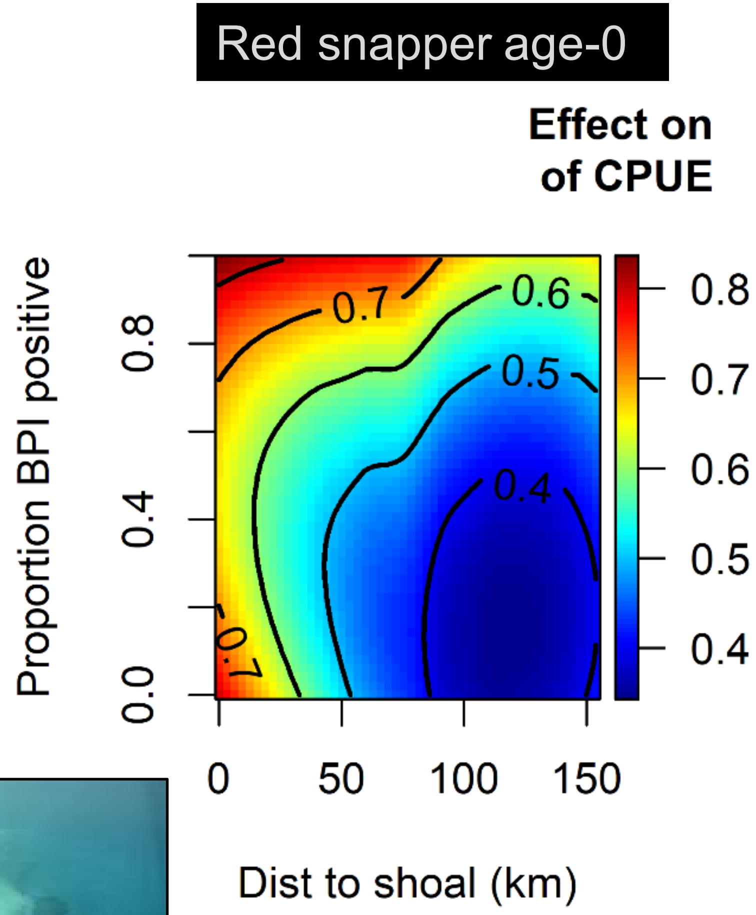
➢ South Atlantic: Estuarine wetland area within 130 km radius





Geomorphology

- Juvenile red snapper known to use sand shoals
- Yes, the model showed a positive relationship, but only of minor importance compared to other variables



Adult Red Snapper

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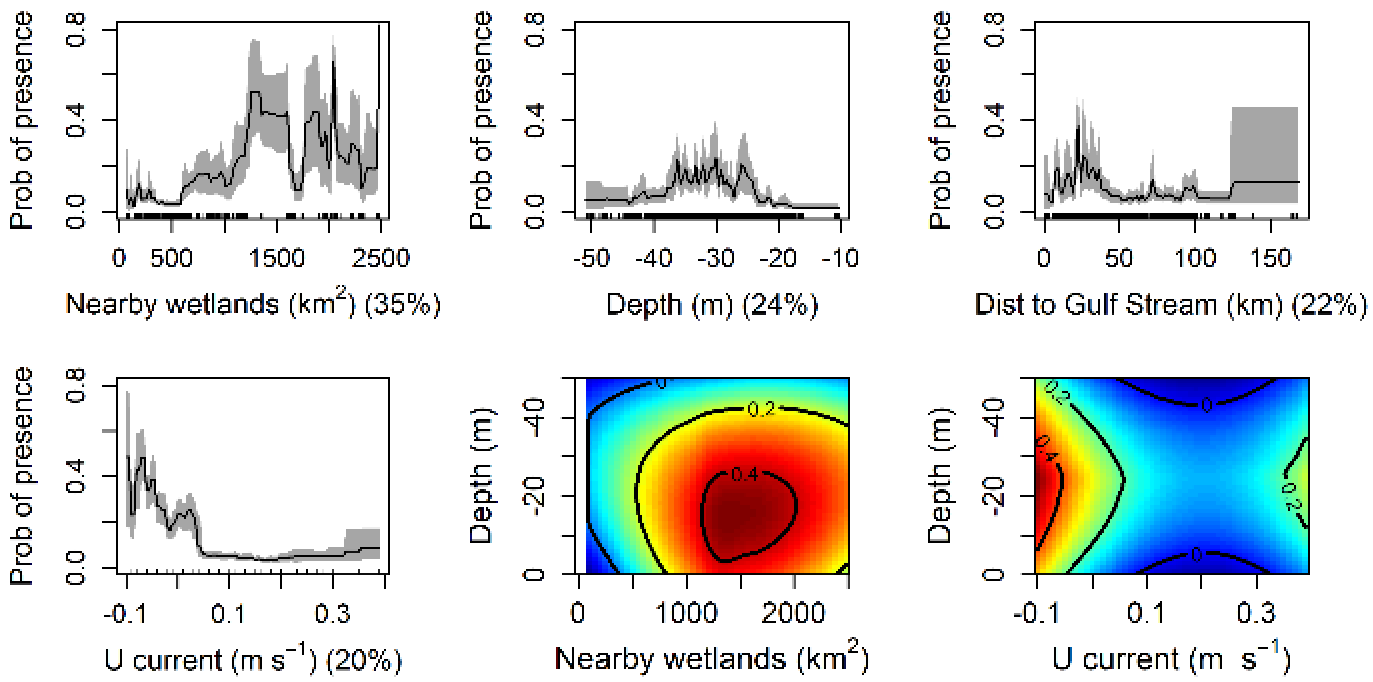
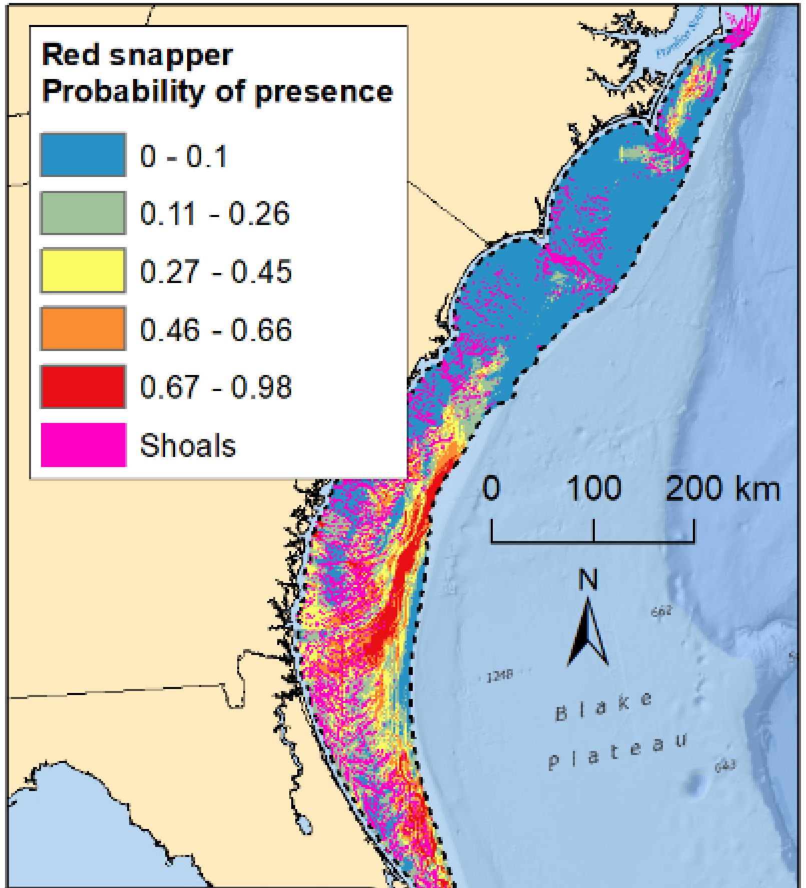
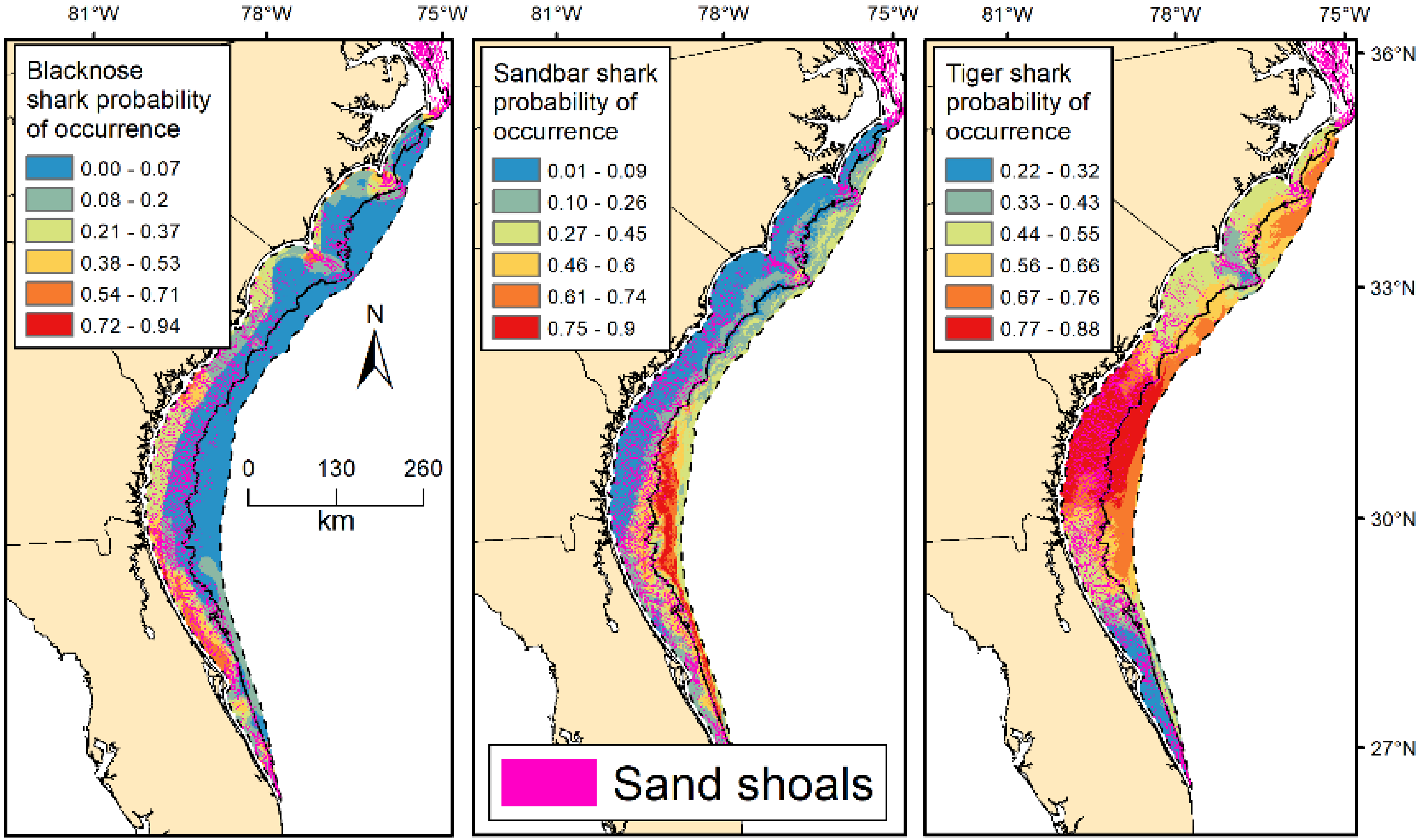




Shark Species Overlap with Sand Shoals

- Some shoals are important
- Blacknose shark-estuary relationship
- Tiger shark-wetland relationship



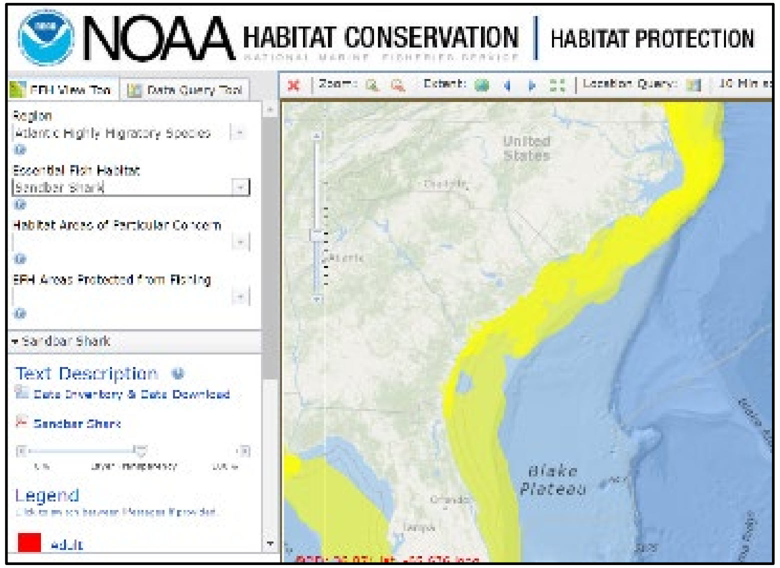
Conclusions

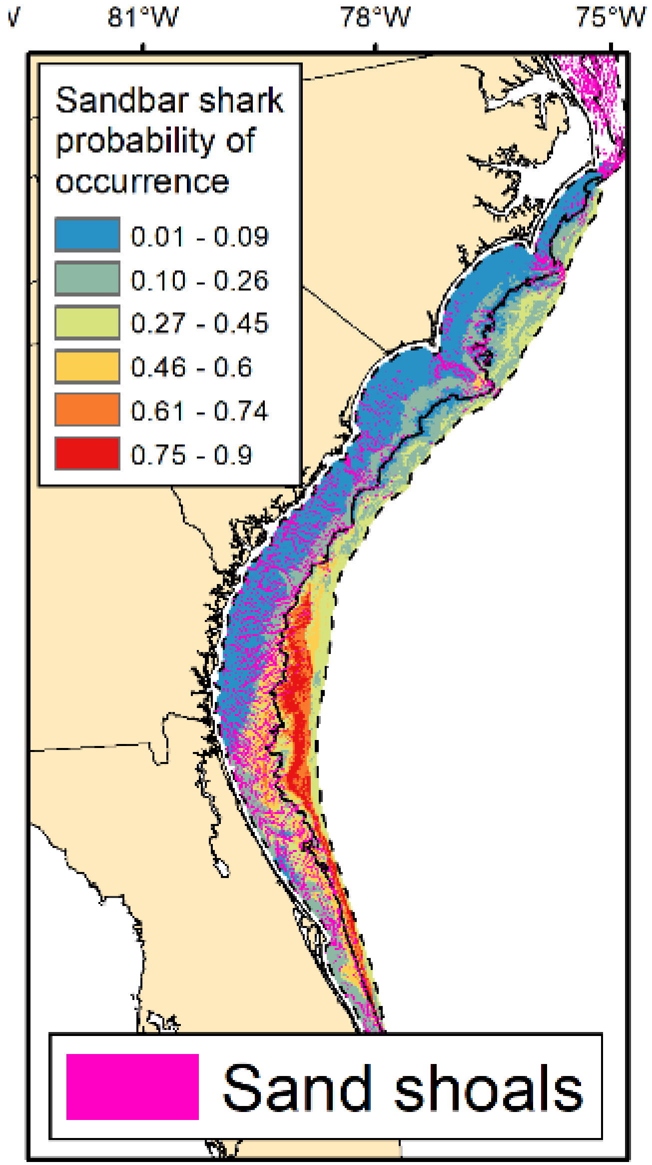
- Value of sand shoals to fish is highly dependent on the context

- Few relationships with geomorphology, but some shoals are more important than others

- Species distribution modeling could inform a review of EFH designation

Sandbar shark





SLIDES OF ShoalMATE

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shoalMATE Shoal Map Assessment Tool for EFH

BOEM

SELECT | RESULTS | MAPS | LAYERS | REPORT

shoalMATE
Shoal Map Assessment Tool for EFH

ShoalMATE supports Essential Fish Habitat (EFH) Consultations. To analyze impacts to EFH from dredging, BOEM staff can walk through this tool to characterize shoal habitat, identify fish distribution statistics (for identified MMIS Sand Resources), and find spatial overlap of EFH. ShoalMATE then generates several maps to show these spatial relationships. The data and maps are compiled automatically in an EFH Assessment for further editing by BOEM staff. The refined prioritized data and automated processes improve both accuracy and consistency of EFH Consultations.

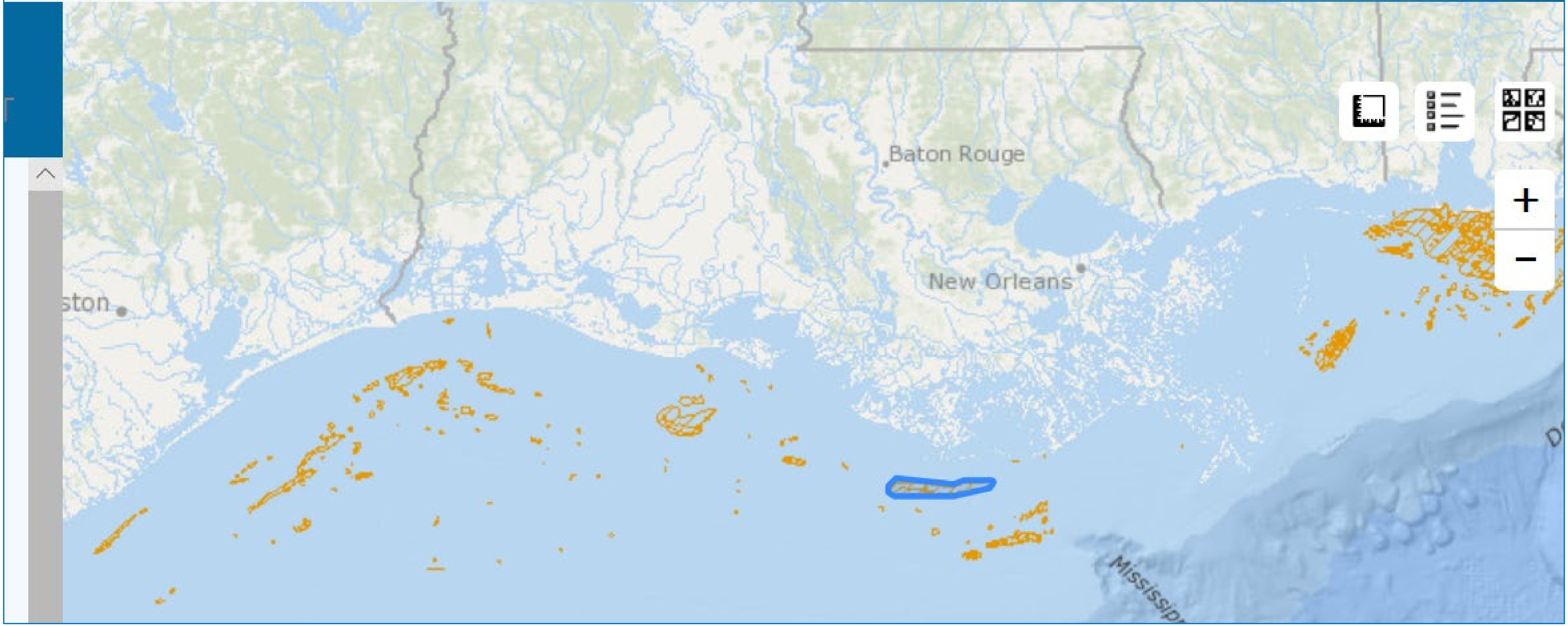
BEGIN ASSESSMENT REPORT

Resources
- MMIS Viewer
- MarineCadastre.gov
- ESPIS
- BOEM MMP

Regional FMCs
- Gulf
- South Atlantic
- Mid Atlantic
- New England

Tool for EFH [Select a shoal & season for proposed dredging]

BOEM Bureau of Ocean Energy Management



Select maps:

1) Overview

2) Bathymetry

3) Bottom types

4) Accretion (if available)

5) Dredging history

6) Customized (fish distribution, oceanography)

shoalMATE Shoal Map Assessment Tool for EFH

BOEM

SELECT | RESULTS | MAPS | LAYERS | REPORT

The buttons below will display the results of an intersection between the selected shoal/sand resource and the indicated layer. An empty table indicates that no overlapping information was available.

INTERSECT ALL EFH SPECIES

VIEW

INTERSECT HABITAT AREAS OF PARTICULAR CONCERN (HAPC)

VIEW

INTERSECT PREDICTED RELATIVE ABUNDANCE MODELS

VIEW

INTERSECT PROBABILITY OF PRESENCE MODELS

VIEW

INTERSECT PAST MMIS LEASE AREAS

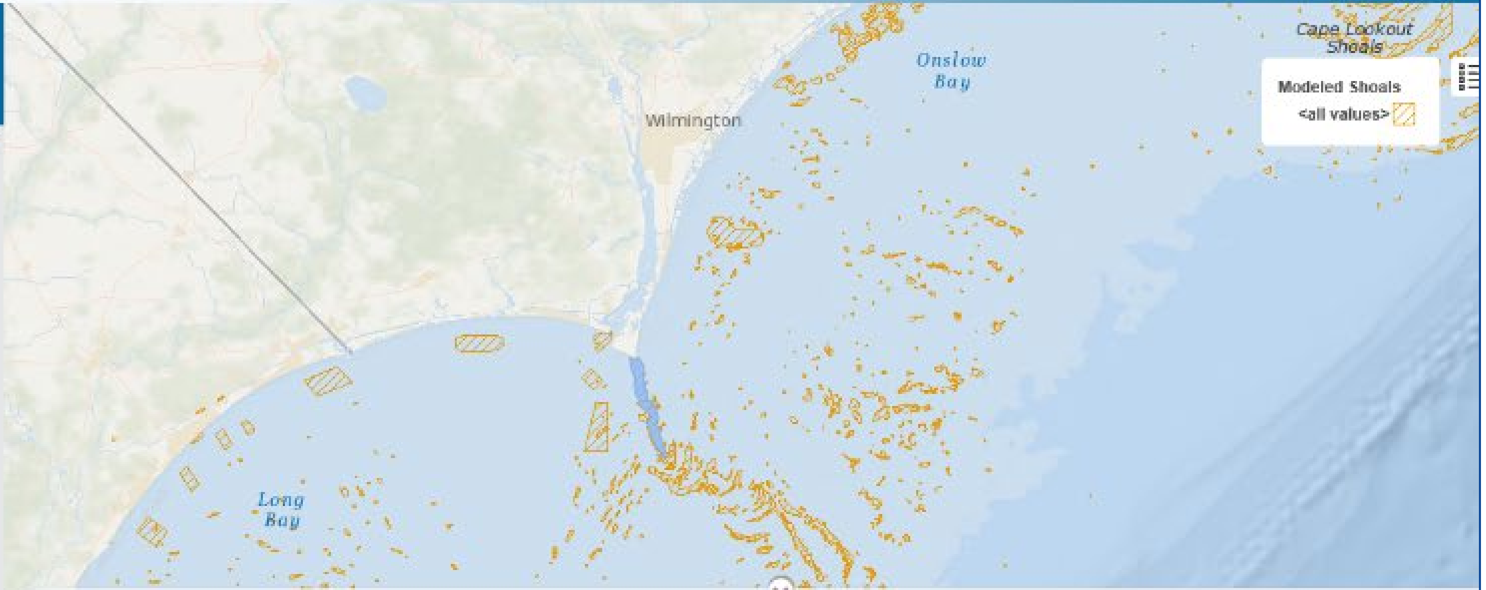
VIEW

INTERSECT MMIS STUDIES

VIEW

SELECT BEST MANAGEMENT PRACTICES

CONTINUE



INTERSECT ALL EFH SPECIES - Click table header to sort data

SpeciesCommonName	LifeStage	Season	TempRange	WaterColumnZone	SandAffinity	DepthRange	ImpactPotential
Windowpane Flounder	Adults	All	X	unk	X	X	High
Windowpane Flounder	Juveniles	All	X	unk	X	X	High
Tomtate	Adults	All	unk	unk	X	X	High
Tomtate	Spawning Adults	Summer	unk	unk	X	unk	High
Tiger Shark	Juveniles;Adults	All	unk	X	X	unk	High
Tiger Shark	Neonate;YOY	All	unk	X	X	unk	High
Summer Flounder	Adults	All	unk	X	X	X	High
Summer Flounder	Juveniles	All	X	X	X	X	High
Spinner Shark	Adults	All	unk	unk	X	X	High
Spinner Shark	Juveniles	All	X	unk	X	X	High
Spinner Shark	Neonate/YOY	All	X	unk	X	unk	High
Spinner Shark	Spawning Adults	Summer	unk	unk	X	unk	High
Scup	Spawning Adults	Summer	unk	unk	X	unk	High
Scalloped Hammerhead Sh...	Juveniles;Adults	All	unk	unk	X	unk	High
Scalloped Hammerhead Sh...	Neonate/YOY	All	X	X	X	X	High
Saucereye porgy	Larvae;Juveniles	All	unk	unk	X	unk	High

Decision-support Tool: shoalMATE

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Species	Age group(s)	Season	Unit	Within Shoal/ Borrow Area	Within 20km	Within Species' Geographic Range Within the Region
Atlantic sharpnose shark	All detected in surveys	Spring;Summer;Fall	sharks/100 hooks/hour	11.96	11.07	8.29
Brown shrimp	All detected in surveys	Summer	individuals/km of trawl	77.96	50.51	77.42
Red snapper	Year 0	Summer	individuals/km of trawl	0.45	0.21	0.32
White shrimp	All detected in surveys	Summer	individuals/km of trawl	11.31	9.02	2.46

Decision-support Tool: shoalMATE

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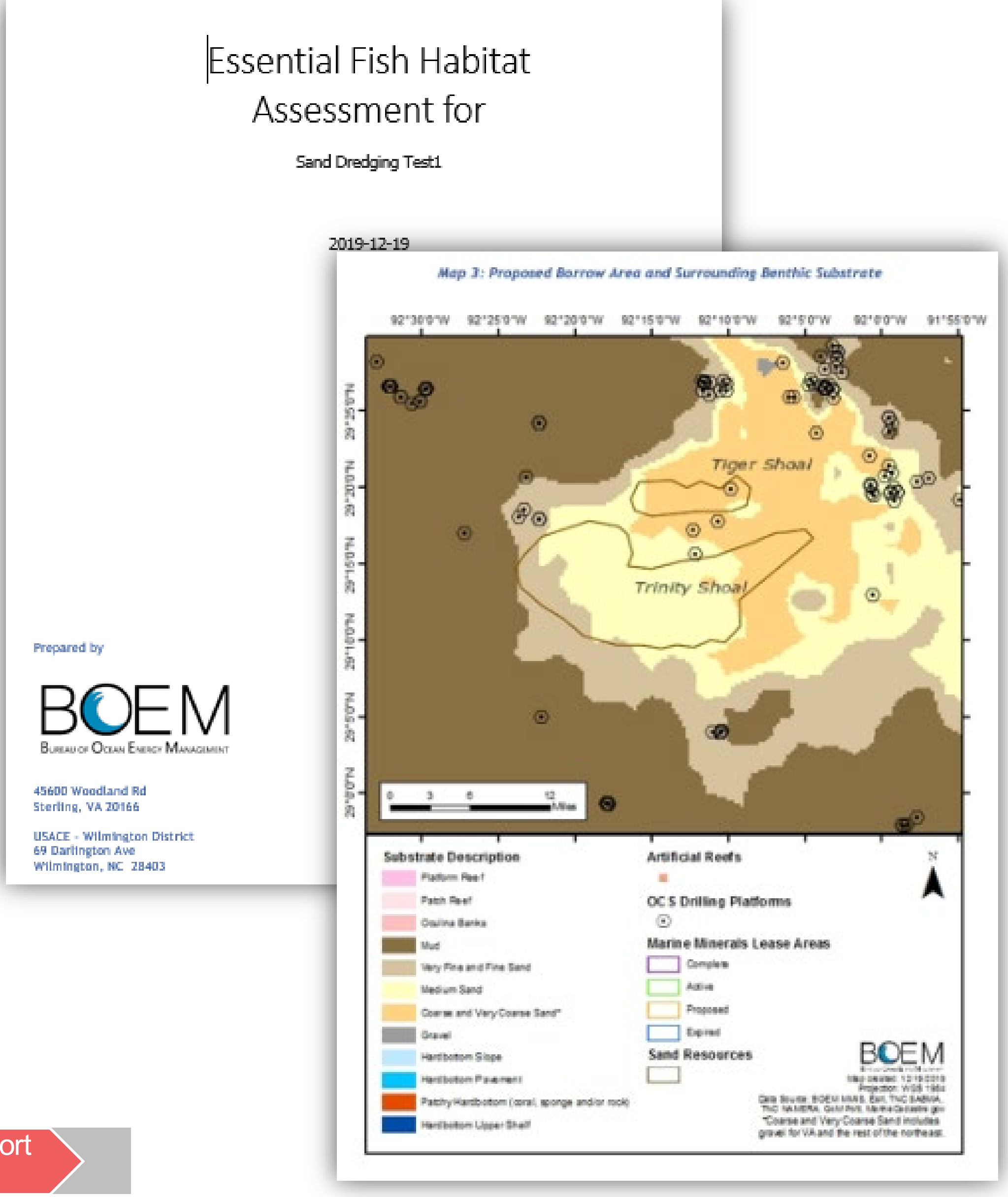
- Tool outputs include:
  - New shoal classifications
  - Dredging history
  - Customized maps of seafloor and oceanography
  - New models of fish distributions
- Automated assessment report streamlines review process:
  - Common language for consistent and transparent EFH assessments
  - All relevant information in **a single geospatial framework**


Essential Fish Habitat Assessment for

Sand Dredging Test1

2019-12-19

Prepared by

BOEM Bureau of Ocean Energy Management

45600 Woodland Rd
Sterling, VA 20166

USACE - Wilmington District
69 Darlington Ave
Wilmington, NC 28403

Frequently Asked Questions

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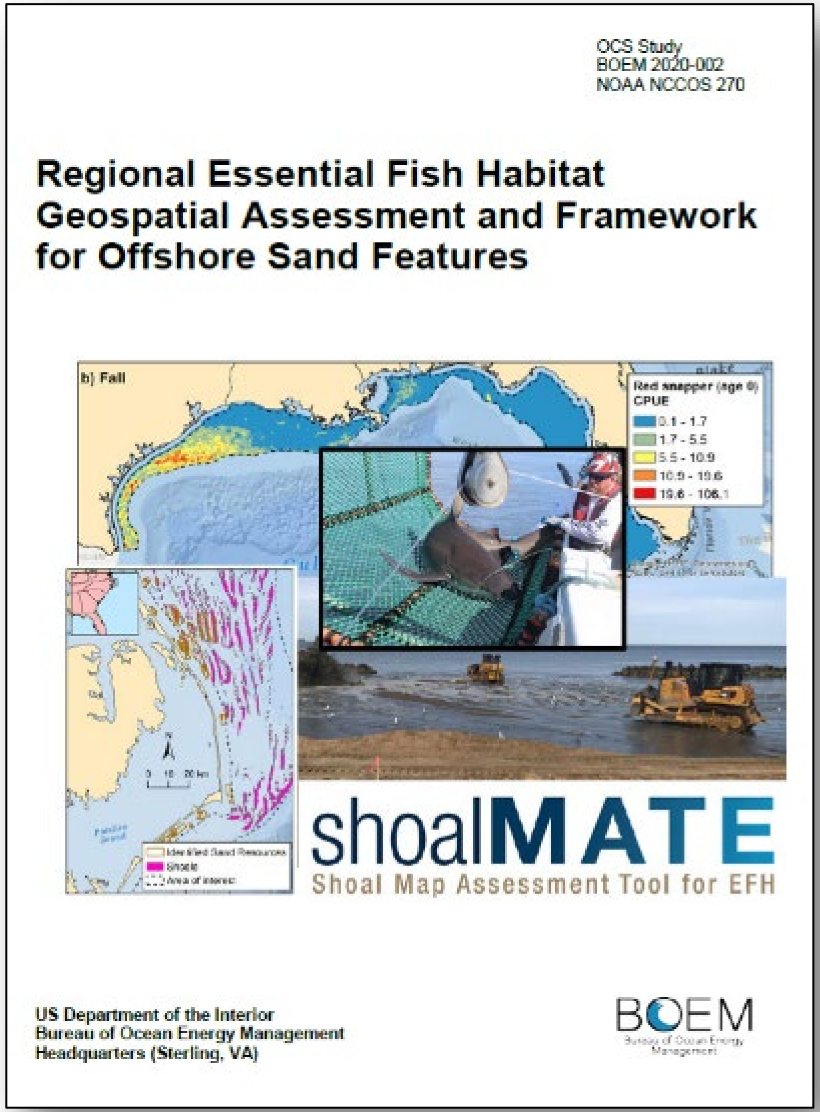
1) What about state-managed waters?
   - Environmental drivers & fish species differ
   - Requires new models in nearshore waters

2) What is the total habitat value of shoals?
   - Here, focus was on EFH designated species
   - Spatial planning possible

3) Largest knowledge gaps?
   - Marine fish distribution data in South Atlantic
   - Forage fish, important prey species
   - Cumulative impacts to fish populations?

4) **Is ShoalMATE available?**


OCS Study
BOEM 2020-002
NOAA NCCOS 270

Regional Essential Fish Habitat Geospatial Assessment and Framework for Offshore Sand Features

US Department of the Interior
Bureau of Ocean Energy Management
Headquarters (Sterling, VA)

BOEM

Questions?

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BOEM/NOAA Technical Report

https://coastalscience.noaa.gov/data_reports/regional-essential-fish-habitat-geospatial-assessment-and-framework-for-offshore-sand-features/

https://marinecadastre.gov/espis/#/search/study/100184

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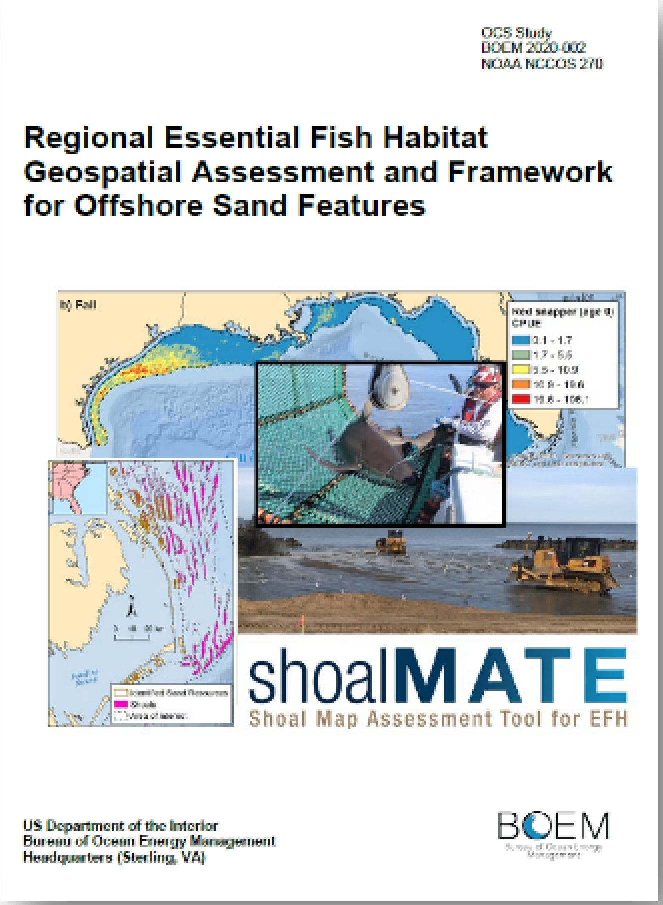


OCS Study
BOEM 2020-002
NOAA NCCOS 270

Regional Essential Fish Habitat Geospatial Assessment and Framework for Offshore Sand Features

shoalMATE
Shoal Map Assessment Tool for EFH

US Department of the Interior
Bureau of Ocean Energy Management
Headquarters (Sterling, VA)

BOEM

shoalMATE
Shoal Map Assessment Tool for EFH

Extra slides follow

NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

I. Introduction

[The following information should be input manually:

- *Description of why project is proposed/why they need sediment on the beach.*
- *Brief description of past projects, if any. This section is expanded on in Section 3.*
- *Who prepared this assessment and why (1 paragraph)*
- *Description of the physical location of the project and coastal features that it is most adjacent to. This section is expanded on in Section 3.]*

See Maps 1-3 for more information on the proposed borrow area and its surrounding environment including bathymetry, bottom currents, and seafloor substrate.

Additional information regarding the proximity of the proposed project to features of interest not covered in this report can be obtained through BOEM and NOAA's Ocean Reporting Tool (NOAA 2018b).

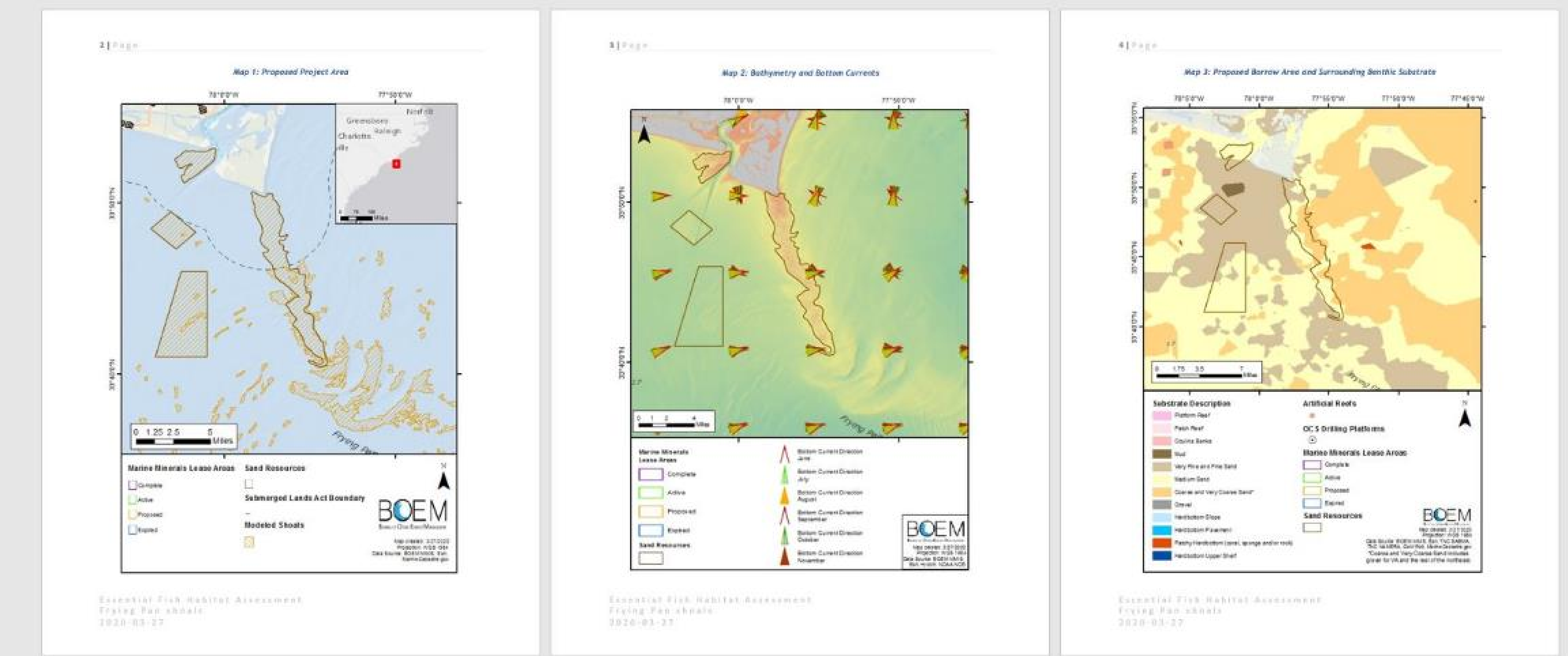
[If Maps 1-3 do not all exist, edit the above reference and the map headers below as applicable.]

Decision-support Tool: shoalMATE

- Oceanography at shoal…

Table 1: Classification and values associated with the proposed borrow area (modified from CMECS)

Attribute	Value	Unit	Classification
Magnitude of Bottom Current - June	0.16	m/s	
Magnitude of Bottom Current - July	0.16	m/s	
Magnitude of Bottom Current - August	0.14	m/s	
Magnitude of Bottom Current - September	0.16	m/s	
Magnitude of Bottom Current - October	0.15	m/s	
Magnitude of Bottom Current - November	0.17	m/s	
Rugosity	1.0		
Slope Range	0.0 - 0.86	Degrees	
Substrate Descriptor			unk
Surface Pattern			
Orientation	339.49	Degrees	
Shelf Position			unk
Accretion Status			unk
Bathymetric Position Index (BPI)	2.31		
Temporal Persistence			unk
Disturbance Regime			unk
Dissolved Oxygen Minimum	4.45	mg/L	
Temperature Range	13.08 - 27.96	Degrees C	
			unk


Map 1: Proposed Project Area
Marine Minerals Lease Areas
Sand Resources
Submerged Lands Act Boundary
Modeled Shoals
BOEM
Map 2: Bathymetry and Bottom Currents
Map 3: Proposed Borrow Area and Surrounding Benthic Substrate
Substrate Description
Artificial Reefs
Marine Minerals Lease Areas
Sand Resources
Essential Fish Habitat Assessment
Frying Pan shoals
2020-03-27

	Life Stage	Season	Temp	Water Column Zone	Sand Affinity	Depth Range	Impact Potential
Bar Jack	Spawning Adults	Summer	unk	unk	X	unk	High
Bar Jack	Spawning Adults	Fall	unk	unk	X	unk	High
Bar Jack	Juveniles	All	unk	unk	X	X	High
Bar Jack	Adults	All	unk	unk	X	X	High
Black Sea Bass	Spawning Adults	Summer	unk	unk	X	unk	High
Black Sea Bass	Spawning Adults	Fall	unk	unk	X	unk	High
Black Sea Bass	Adults	All	unk	unk	X	X	High
Blacknose Shark	Juveniles;Adults	All	X	X	X	X	High
Blacktip Shark	Neonate/YOY	All	unk	unk	X	X	High
Blacktip Shark	Juveniles;Adults	All	X	unk	X	X	High
Bluefish	Larvae	Summer	X	unk	X	unk	High
Bluefish	Larvae	Fall	X	unk	X	unk	High
Bluefish	Juveniles	Summer	unk	unk	X	unk	High
Bluefish	Juveniles	Fall	unk	unk	X	unk	High
Bluefish	Eggs	Summer	X	unk	X	unk	High
Bluefish	Adults	Summer	unk	unk	X	unk	High
Bluefish	Adults	Fall	unk	unk	X	unk	High
Bonnethead Shark	Neonate/YOY	All	X	unk	X	X	High

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1.25 Scup

http://safmc.net/fishery-management-plans-amendments/snapper-grouper-fishery-management-plan/

Spawning Adults

http://safmc.net/download/FEP_VolumeII_2009.pdf

1.25.1 [Potential Project Impacts]

[Insert further applicable information manually if available. Delete if this section is empty.]

1.26 Spinner Shark

https://www.fisheries.noaa.gov/webdam/download/69616917

Spawning Adults

https://www.fisheries.noaa.gov/webdam/download/69616917

Neonate/YOY

https://www.fisheries.noaa.gov/webdam/download/69616917

Juveniles

https://www.fisheries.noaa.gov/webdam/download/69616917

Adults

https://www.fisheries.noaa.gov/webdam/download/69616917

1.26.1 [Potential Project Impacts]

[Insert further applicable information manually if available. Delete if this section is empty.]

V. Evaluation of Impacts on EFH Species

Fish species' presence within waters of the project impact area is highly variable, both spatially and temporally. Presence can vary for highly migratory species, among life stages, and seasonally.

The short-term impacts of dredging on fish include entrainment, physiological or behavioral changes due to human-made sounds, loss of prey/food web effects, loss of bottom substrate, and effects due to suspended and resuspended sediment plumes, sedimentation of the seafloor, and the potential release of contaminants (Kim et al. 2008; Suedel et al. 2008; Wenger et al. 2017). Hopper and cutterhead dredges use hydraulic suction fields to obtain and transport unconsolidated sediments from aquatic ecosystems. These actions may result in the *entrainment* of fish and shellfish, as defined as the direct uptake of organisms due to the hydraulic suction field generated by a draghead or cutterhead dredge (Reine et al. 1998).

Sounds from dredging operations are produced from vessels in transit to/from the dredging location, supporting vessels, and the dredging operation itself (see Reine et al. 2014a; Reine et al. 2014b; Robinson et al. 2012; Pickens and Taylor 2020). Underwater sounds emitted from dredging operations are of the amplitude to affect the behavior of fish at a considerable distance from the dredge operation (~400-1,200 m). However, the maximum sound levels emitted by dredge activities are restricted to approximately 0-300 m from the source of the vessel. These sounds are not at a level that would result in mortality or severe injury. At the closest proximities, effects may include permanent or temporary hearing impairment. Expected behavioral changes where sound is above ambient conditions may include avoidance, masking of conspecific communication, masking of predator or prey detection, or other behavioral changes. Avoidance could have severe consequences if the particular area is critical for spawning, habitat is limited in the near vicinity, migratory corridors are blocked, or the area is important for other life history requirements (Pickens and Taylor 2020).

Regarding suspended sediments, the rotation of the cutterhead itself (for cutterhead dredges) produces substantial sediment resuspension in the lower part of the water column; plume concentrations at the surface of the water column may be half of the concentration at the bottom (Havis 1988). Overflow from hopper dredges can be extremely turbid in close proximity to the dredge, as fine-grained TSS may