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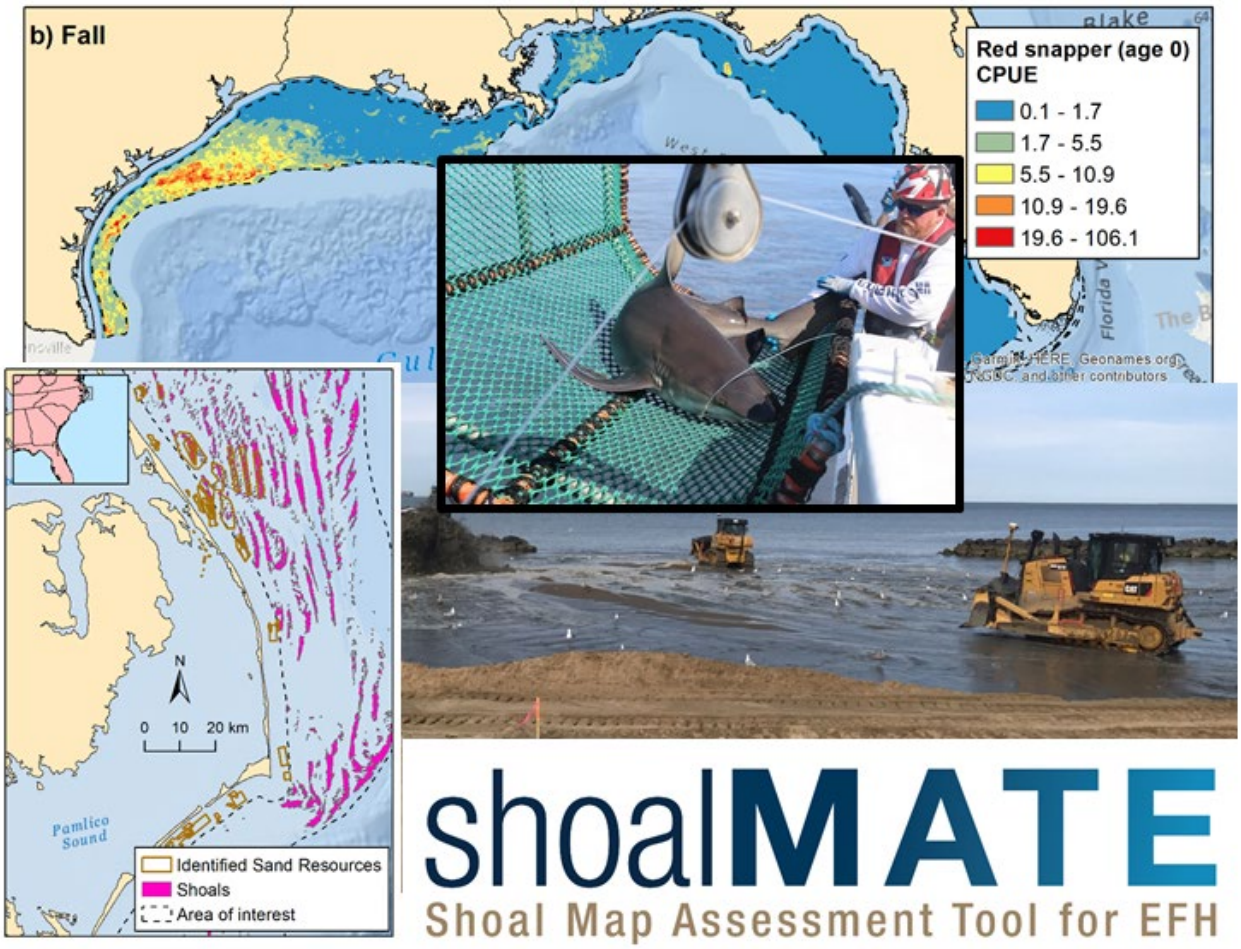
Regional Essential Fish Habitat Geospatial Assessment and Framework for Offshore Sand Features



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

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Editors:
Bradley A. Pickens[1,2]
J. Christopher Taylor[1]

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[1]NOAA, National Ocean Service, National Centers for Coastal Ocean Science, Biogeography Branch, 101 Pivers Island Road, Beaufort, North Carolina, USA 28516
and
[2]CSS-Inc., 10301 Democracy Lane, Suite 300, Fairfax, Virginia 22030, USA; Under NOAA/NCCOS Contract #GS-00F-217CA

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DISCLAIMER

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List of Abbreviations and Acronyms

BOEM	Bureau of Ocean Energy Management
CMECS	Coastal Marine Ecological Classification Standard
CPUE	catch per unit effort
EFH	Essential Fish Habitat
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
nm	nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
SDM	species distribution model
ShoalMATE	Shoal Map and Assessment Tool for EFH

1 Executive Summary

1.1 Background

The demand for marine sand resources is increasing in the United States (Drucker et al. 2004), as coastal and offshore sands are commonly used for beach renourishment and barrier island restoration. The dredging of the Outer Continental Shelf (OCS), and sand shoals in particular, is likely to increase in the near future because nearshore sand resources are being depleted while demand increases due to renourishment cycles for beaches, emergency repairs of beaches after storms, and the projected effects of sea-level rise (Nairn et al. 2004). The Bureau of Ocean Energy Management (BOEM), as part of the U.S. Department of the Interior, is responsible for the management and development of energy and mineral resources on the OCS, including marine minerals. Concurrently, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), written in 1976 and amended in 1996 and 2007, has the objectives of preventing overfishing, rebuilding overfished stocks, increasing long-term economic and social benefits, and ensuring a sustainable supply of seafood. Under the Magnuson-Stevens Act, the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) is responsible for identification and protection of "Essential Fish Habitat" (EFH) of federally managed marine and anadromous fishes during each of their life stages. Projects authorized or conducted by the Federal Government must consult with NMFS regarding EFH to ensure full consideration of the environmental effects and possible mitigation measures so that fish and their habitats are not adversely affected. This study follows an comprehensive literature review by Rutecki et al. (2014) on sand shoal geology, geography, and general biological value. Here, we concentrate on the attributes of sand dredging that relate directly to fish and EFH: the potential impacts of dredging on fish, a synthesis of known fish habitat associations, and the development of predictive models to identify the location and types of shoals and distribution of fish species. These new data were then incorporated into an interactive mapping tool “ShoalMATE” that generates semi-automated reports for the EFH consultation process.

1.2 Scope of the Report

The project covers the shallow waters of the OCS for the Atlantic and US Gulf of Mexico. More specifically, the landward boundary of the study area was defined by the Outer Continental Shelf Lands Act (1953), which distinguishes Federal and state jurisdictions (3 nm for all states except 9 nm for Gulf coasts of Florida and Texas). The oceanic boundary of the study area was defined by a 50-m contour line from NOAA’s Coastal Relief Model (NOAA National Centers for Environmental Information 2010). Only waters ≤ 50 m deep were included in this study because logistics and costs of dredging in deeper depths and distance from shore generally prohibits dredging projects in deeper waters. Throughout this report, we use the term "sand" to broadly characterize sediment resources, and we recognize that sediment dredging may include a variety of grain sizes depending on the application. The report presents the key findings in four volumes as described below.

1.3 Key Findings

Volume 1: Fish Habitat Associations and the Potential Effects of Dredging on Fish of the Atlantic and Gulf of Mexico Outer Continental Shelf. A Literature Synthesis and Gap Analysis

This volume synthesizes the latest international scientific knowledge on the direct effects of dredging on fish and their habitats, as well as reviews the state-of-science on fish habitat associations. Sand and

sediment dredging in the OCS of the Atlantic and US Gulf of Mexico has expanded in recent years as demand for sediments has increased. Marine sediment dredging occurs in shallow waters (≤ 50 m) and often utilizes sand shoals, where large volumes of sand can be efficiently extracted. With the goal of understanding the effects of dredging on fish, we first synthesize the known effects of sand dredging. This includes the potential dredging effects of hydraulic entrainment, underwater sounds, suspended sediments, and substrate removal. Secondly, fish habitat use and distributions are major determinants of dredging effects. A synthesis of international literature on spatially explicit marine fish distribution models and habitat associations provides context for the latest technologies for mapping fish distributions. We also synthesized the documented regional habitat associations specifically for federally managed species in the Gulf of Mexico, South Atlantic, and Greater Atlantic. Overall, the literature synthesis summarizes how dredging may affect fish species and how the distribution of fish is influenced by physical, biological, and chemical habitat factors

Volume 2: Shoal Identification and Classification of Sand Resources

This volume comprises two components. First, we develop a predictive model for identifying and delineating potential sand shoals using broadly available, unified digital elevation models for the seafloor along the Gulf of Mexico and Atlantic coastlines from 3 nm from shore to the 50-m depth contour. Seafloor complexity and relief metrics were derived from the Coastal Relief Model and used to predict areas of relative higher relief and to produce polygons showing geomorphological features consistent with sand shoals, ridges, and swales. Maps depict bedforms, shoal complexes, and yet-unclassified features along the Gulf and Atlantic coastlines. Recognition of these features in the context of EFH and sand resource demand will aide in improved planning and permitting for sand dredging activities. We then classify these features and sand shoals according to a new scheme developed by subject matter experts in the fields of geology, biology, and seafloor habitats during three facilitated workshops and webinars. This new classification scheme is proposed for adoption under the Coastal Marine Ecological Classification Standard (CMECS) as a new schema for classifying OCS sand features.

Volume 3: Predicting the Distribution of Select Fish Species of the Gulf of Mexico, South Atlantic, and Greater Atlantic

This volume presents the scientific analysis and results of predictive modeling for select federally managed fish. Species distribution models (SDMs) are a state-of-the-art statistical modeling approach that quantifies the relationships between species and spatially explicit environmental data. SDMs work by extending the identified species-habitat relationships to the entire distribution of species under consideration. These predictive modeling results are ideal to inform management decisions. In this volume, we used a variety of fisheries-independent data sources in the Gulf of Mexico and South Atlantic to produce SDMs for select marine fish and shrimp species. Environmental data on habitats included oceanographic conditions, geomorphology, geography, prey, and the nearby ecosystems of wetlands and estuaries. For the Greater Atlantic, we summarize SDMs developed by the Northeast Fisheries Science Center which combined trawl surveys with data on oceanographic conditions, substrate, and zooplankton. Together, these maps and quantified habitat relationships (or lack thereof) add to the information synthesized in Volume 1, "Fish Habitat Associations and the Potential Effects of Dredging on the Atlantic and Gulf of Mexico Outer Continental Shelf." The analyses evaluated the best habitat predictors of marine species and depicted the distribution of select marine fish and shrimp species. Species' relationships with geomorphology characteristics were limited and of minor importance compared to other habitat predictors. None of the Gulf of Mexico species examined were related to bottom currents, slope, or heterogeneity of depth. Of minor importance in the models, white shrimp had a higher catch per unit effort (CPUE) farther away from shoals, and pink shrimp were positively related to sand grain sizes. Red snapper age-0 had a higher CPUE in close proximity to shoals and where the bathymetric position index predominately showed a hill topography. In the South Atlantic, none of the five species examined were associated with geomorphology characteristics. Overall, species' distributions were primarily related

to oceanographic conditions, nearby wetlands and estuaries, and prey species. When applicable, geomorphology predictors only had minor influence on species' distribution.

Volume 4: Development of ShoalMATE: Shoal Map Assessment Tool for Essential Fish Habitat

This volume outlines the process and framework used to develop the interactive mapping tool, user interface, and automated reporting of ShoalMATE (Shoal Map and Assessment Tool for EFH). ShoalMATE was conceived as a standardized reporting tool to facilitate better communication between BOEM and NOAA during EFH assessments required for dredging projects on the OCS. Development initiated by gathering requirements from BOEM's Marine Minerals Program and NOAA's Habitat Conservation Division. A database architecture and workflow were proposed to meet the needs of access and usability for stakeholders with varying levels of familiarity with Geographic Information Systems. We ran the data necessary to support the tool (e.g., habitat descriptors, species models, project boundaries) through a series of custom scripts that store information describing each identified shoal in a database that was specifically designed for expedited queries within the front-end application. The front-end application presents this queried information within a web browser and generates a template report as a Microsoft Word document, which can be edited by analysts to create a final, consistent product across a range of geographies and project extents.

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