Environmental Studies Program: Ongoing Study

Title	Assessment of Ship Shoal Borrow Areas for Coastal Restoration of Louisiana Barrier Islands (GM-14-03-10)
Administered by	Gulf of Mexico OCS Region
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Procurement Type(s)	Cooperative Agreement
Conducting Organizations(s)	Louisiana State University and BOEM
Total BOEM Cost	$460,900
Performance Period	FY 2016–2021
Final Report Due	September 7, 2021
Date Revised	August 27, 2021
PICOC Summary	
Problem	State, Local and Federal Government would be affected in that this information may assist assessing impacts of dredging OCS sands for coastal restoration projects.
Intervention	Analyze physical evolution of an OCS borrow area to evaluate the temporal evolution in respects to habitat.
Comparison	Quantify borrow area geomorphic evolution by collecting new physical oceanographic, geological, and geophysical data in two borrow areas on Ship Shoal
Outcome	Quantify and greatly enhance our understanding of dredge area evolution through the development of a conceptual geomorphic evolutionary model.
Context	Gulf of Mexico

BOEM Information Need(s): Alterations to seafloor topography associated with excavating outer continental shelf (OCS) sediment resources have the potential to affect oil and gas infrastructure or other resources of concern located proximal to borrow areas. Moreover, the physical evolution of borrow areas post-dredging is important to understand so that temporal aspects of impacts to habitat can be understood. Defining the rate and sedimentary character of borrow area infilling also has implications for renewability of these borrow areas for future use, potentially offsetting impacts that might be felt if pristine areas are dredged. How to best utilize the sand resources and minimize hazards associated with oil and gas infrastructure (Nairn *et al.*, 2005), impacts to sensitive seafloor habitat, and impacts to potential cultural resources (Research Planning *et al.*, 2004) are the interests of Bureau of Ocean Energy Management (BOEM) Marine Minerals Program and the State of Louisiana.

Background: Barrier islands are sandy sedimentary environments separated from the mainland by estuary or lagoon environments. The barriers protect the mainland coast and interior wetlands from meteorological and marine forcings and help to regulate estuarine conditions. A major component of the State of Louisiana's effort to manage coastal land loss is to restore degraded barrier shorelines by

dredging sand resources from offshore borrow sites and delivering to the coastal sedimentary environments. Offshore excavation, however, can impact the sea floor habitat.

Major sand resources on Louisiana shelf are submarine sandy shoals, such as Ship Shoal, Tiger and Trinity Shoals, and Sabine Bank. These sandy shoals are under the combined influence of wind driven currents, storm waves, tides, and the dynamic Atchafalaya and Mississippi River sediment dispersal systems. They may also provide spawning, hatching and foraging ground and serve as important biological habitats for a variety of nekton species (Munnelly, 2016). During past several decades numerous oil and gas pipelines have been constructed and are often abandoned in place across these sandy shoals. These active and abandoned pipelines must remain buried with three feet of sediment cover. Sand excavation temporarily disrupts geomorphic equilibrium and post-dredging the borrow area rapidly evolves as it recovers to return to equilibrium under the influence of waves, tides, wind-driven currents, and sediment supply. Physical changes to the seafloor may extend beyond the dredged area during this recovery period and could compromise adjacent sediment cover over pipelines or cultural resources. The timing, character, and geometry of the physical recovery of the borrow area also has implications to alter seafloor habitat.

Objectives:

1) Quantify borrow area geomorphic evolution by collecting new physical oceanographic, geological, and geophysical data in two borrow areas on Ship Shoal (Whiskey Island borrow area in Ship Shoal Block 88 and Caminada Headland Borrow Area in South Pelto Blocks 12, 13, and 14).
2) Validate/refine existing Nairn et al. (2005) predictive numerical model using newly collected data.
3) Quantify and greatly enhance our understanding of dredge area evolution through the development of a conceptual geomorphic evolutionary model.
4) Characterize (e.g., textural properties, percent sand) borrow area infill sediment and quantify accumulation rates.
5) Assess effectiveness of existing mitigations.
6) Provide recommendations for future research and borrow area monitoring protocols (e.g. assigned setback buffers), and suggest mitigations based on empirical measurements.
7) Apply new model framework to predict borrow area evolution, develop a monitoring protocol, and suggest future mitigations.

Methods: Field data collection methods include: 1) hydrodynamic observation and hydrographic/water quality data collection (waves, currents, temperature, salinity, turbidity and dissolve oxygen etc.) using bottom-mounted ADCP, vessel-based transect surveys, and CTD casts across the borrow areas. In addition, BOEM has just funded a project (PI Chunyan Li) to reactivate a real time observation station (CSI 5) which is very close to the Ship Shoal study site. WAVCIS will provide unique background weather and physical oceanography time series data for the interpretation of the sediment transport and associated geomorphological changes; 2) Tripod-based time-series observations of bottom boundary layer near the borrow areas using acoustic and optical sensors (sea bed elevation change, velocity, sediment concentration and flux); 3) shallow geophysical surveys using high-resolution swath bathymetry, side-scan sonar, and seismic sub-bottom profiler, and 4) collection of vibracores and multicores and texture and radionuclide analyses of coring sediment.

Eight days of fieldwork at Caminada dredging pit in Year 1, 15 days of fieldwork at Caminada and Block 88 in Year 2, and 15 days of fieldwork at Caminada and Block 88 in Year 3 are proposed. Tripod fieldwork will be performed at Caminada only in Year 2 and Block 88 only in Year 3. The R/V Coastal Profiler (berthed at Louisiana Universities Marine Consortium - LUMCON) from Coastal Studies Institute (CSI) of LSU will be used to collect data during daytime only. Horizontal and vertical controls of geophysical surveys are key to the success of our proposed project.

Over the last 15 years, LSU Center for GeoInformatics (C4G) & the LA Spatial Reference Center have established a Louisiana statewide network of over 70 Continuously Operating Reference Stations (CORS), 26 of which are National CORS providing the data that ties Louisiana into the National Spatial Reference System. This is a consistent national coordinate system that specifies latitude, longitude, height, scale, gravity, and orientation throughout the Nation, as well as how these values change with time (from http://c4gnet.lsu.edu/). As of now Caminada and Block 88 dredging pits are all under the spatial coverage of C4G network. All the bathymetric data collected in this project will be referenced to North American Vertical Datum of 1988 (NAVD88). The LSU CSI Field Support Group uses several options for subscription-based survey-grade positioning during offshore geophysical studies.

The R/V Coastal Profiler is equipped with a Fugro Marinestar satellite-based GPS correction that provides decimeter accuracy and precision for both vertical and horizontal position. Our swath bathymetry is corrected for vessel motion, with all necessary corrections for antenna and sensor locations accounted for.

Specific Research Question(s): Evaluate the physical evolution of an OCS borrow area to understand the temporal aspects of impacts to habitat.

Current Status: All data collection and analysis has been completed. Final report is pending review.

Publications Completed: Liu, H., Xu, K.H., Li, B., Han, Y., Li, G., 2019 Sediment Identification Using Machine Learning Classifiers in a Mixed-Texture Dredge Pit of Louisiana Shelf for Coastal Restoration. Water, 11, 1257. https://www.mdpi.com/2073-4441/11/6/1257 .

Affiliated WWW Sites: N/A

References:

Munnelly, R., 2016, Fishes Associated With Oil and Gas Platforms In Louisiana's River-Influenced Nearshore Waters, Masters' Thesis, Louisiana State University, Baton Rouge, LA. pp. 166.

Nairn, R.B., Lu, Q., Langendyk, S.K., and Michel, J., 2005, A study to Address the Issue of Seafloor Stability and the Impact on Oil and Gas Infrastructure in the Gulf of Mexico: U.S. Department of Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA, OCS Study, MMS 2005-043, 179 p. with appendices.

Research Planning, Inc., Tidewater Atlantic Research, Inc., and Baird & Associates Ltd., 2004. Archaeological Damage from Offshore Dredging: Recommendations for Pre-Operational Surveys and Mitigation During Dredging to Avoid Adverse Impacts. U.S. Department of the Interior, Minerals Management Service, Sand and Gravel Unit, Leasing Division, Herndon, VA. OCS Report MMS 2004-005, 75 pp. + appendices.