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THEMATIC SECTION

The U.S. Minerals Management Service Outer Continental Shelf Sand and Gravel Program: Environmental Studies to Assess the Potential Effects of Offshore Dredging Operations in Federal Waters

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ABSTRACT

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The U.S. Department of the Interior, Minerals Management Service, provides policy direction relative to the development of all marine mineral resources located beneath Federal waters of the United States. Over the last ten years or so, geological studies encompassing the collection and analysis of seismic, vibracore, and grain size data have been conducted in partnership with coastal States in the Atlantic and Gulf of Mexico to locate suitable sources of compatible sand for beach and coastal restoration. Environmental studies have been initiated to provide biological, physical, and other pertinent information for decisions regarding leasing and use of this resource. Aggregate dredging studies also have been conducted in the event that an offshore aggregate mining operation is proposed in the future. A symposium was held in New Orleans in January 2002 to report results from several studies completed over the past 2 years. The papers prepared for this Special Issue summarize the findings of recently completed environmental studies.

ADDITIONAL INDEX WORDS: *Beach nourishment, coastal restoration, sand shoals, aggregate mining, wave modeling.*

INTRODUCTION

The Federal Outer Continental Shelf (OCS) represents a viable source of industrial minerals and materials, such as titanium and phosphate, as well as sand and gravel for beach restoration and construction aggregate. These resources are under the jurisdiction of the Minerals Management Service (MMS), a bureau within the U.S. Department of the Interior. The OCS is defined as the submerged lands, subsoil, and seabed, lying between the seaward extent of State jurisdiction and the seaward extent of Federal jurisdiction. For most States, offshore Federal lands begin 3 nautical miles (approximately 3.3 statute miles) seaward of the baseline from which the breadth of the territorial sea is measured. Offshore Texas and the Gulf coast of Florida, the boundary is at the 3 marine leagues (9 nautical miles) mark. The seaward limit of Federal jurisdiction is defined as the farthest of 200 nautical miles seaward of the baseline from which the breadth of the territorial sea is measured or, if the continental shelf can be shown to exceed 200 nautical miles, a distance not greater than a line 100 nautical miles from the 2,500-meter isobath or a line 350 nautical miles from the baseline.

Initially, the MMS marine minerals program focused on offshore material that could serve as a source of commercially important raw materials and minerals (manganese nodules, polymetallic sulfides, titanium resources, *etc.*) As far back as 1989, however, MMS detected a trend toward greater interest in offshore sand resources. In 1993, Congress recognized the potential benefits of using Federal offshore sand for coastal restoration projects and crafted legislation to remedy what was considered an impediment to State and local government access to Federal sand resources. The impediment was the competitive leasing provision of the Outer Continental Shelf

1 received and accepted in revision 6 June 2003.

Figure 1. Location of MMS State/Federal Cooperative Efforts.

Lands Act (OCSLA). Under this provision, State and local governments expressed little interest in pursuing rights to Federal sand through a lengthy competitive process that could ultimately award the resource to another (higher) bidder. They viewed this uncertainty as an unacceptable risk. Congress remedied the situation by passing Public Law 103-426 in October 1994 which amended the OCSLA by providing the Secretary of the Interior with new authority to negotiate agreements for use of Federal sand, gravel, or shell resources under certain circumstances. The passage of this law has greatly accelerated the demand for Federal offshore sand, specifically for public works related projects.

All studies presented in this JCR Special Issue were funded through the MMS Environmental Studies Program (ESP). The ESP was initiated in 1973 as a means to gather and synthesize environmental, social, and economic science information to support decision-making concerning the MMS offshore oil and gas and marine minerals programs. Section 20 of the Outer Continental Shelf Lands Act authorizes the ESP and establishes the general goal for the program: *establish the information needed for assessment and management of environmental impacts on the human, marine, and coastal environments of the OCS and the potentially affected coastal areas.*

STATE/FEDERAL COOPERATIVE PROGRAMS

A key strategy to ensure environmental protection, safe operations, and issue resolution for decisions regarding access to OCS sand and gravel material has been the closely coordinated partnerships between the Federal Government, coastal States, and local communities. The MMS has developed cooperative agreements with Alabama, Delaware, Florida, Louisiana, Maryland, New Jersey, North Carolina, South Carolina, Texas, and Virginia. Discussions are currently underway with the states of Maine, Massachusetts, and California regarding new Federal/State partnerships to investigate potential sand sources for beach nourishment offshore their respective coasts. These partnerships rely primarily on State Geological Surveys, in cooperation with other State and Federal agencies, to identify State needs and propose suitable offshore areas for study.

The State/Federal partnerships have focused primarily on isolated, relict submerged shoals and surficial sand sheets which represent viable sources of sand borrow material for coastal erosion management. In the near future, sand investigations will broaden to include such promising deposits as buried paleochannels and shoreface-attached sand ridges. The use of sand in Federal waters is becoming more important and more viable due to the general diminishing supply of onshore and nearshore sand, the renourishment cycles for beaches or coastal areas requiring quantities of sand not currently available from State sources, and the need for sand for immediate and/or emergency repair of beach and coastal damage from severe coastal storms.

The first phase of each cooperative program involves compiling and inventorying beach erosion along the entire coast of each State and identifying areas where sand for future nourishment would be needed most. Geological studies, which encompasses the collection of shallow seismic and vibracore data, are initiated to document potential sand sources and estimate volumes of usable and compatible sand available for beach nourishment. Figure 1 shows the location of State/Federal sand investigations to date.

OCS SAND AND GRAVEL ACTIVITIES

The sand and gravel program has been steadily moving to an operational phase from what was once purely a research

Table 1. *Cubic yards of Federal OCS sand conveyed as of June 1, 2003.*

State	Locality	Cubic Yards Conveyed
Florida	Jacksonville (Duval County)	1,240,000
South Carolina	Myrtle Beach (Surfside)	150,000
Virginia	Dam Neck Naval Facility	808,600
Virginia	Sandbridge Beach	1,098,191
Maryland	Assateague National Seashore	134,000
Florida	Brevard County	7,300,000
Florida	Patrick Air Force Base	600,000
Louisiana	Holly Beach	4,200,000
Louisiana	Ship Shoal Dredge Test	3,000
Virginia	Sandbridge Beach	2,000,000
Maryland	Assateague Island	1,800,000

phase. Since Public Law 103-426 was enacted, MMS, as of mid-April 2002, had conveyed over 19 million cubic yards of sand to State, local, and Federal entities (Table 1). A number of negotiated leases also are pending or are a possibility in the near-term (Table 2).

ENVIRONMENTAL STUDIES

OCS sand and gravel resources must be managed effectively to ensure that environmental damage to marine and coastal environments will not occur. MMS has focused on integrating resource data provided through State/Federal cooperative efforts to identify suitable OCS sand deposits, and provide needed environmental information to make decisions regarding the use of Federal sand for future beach nourishment activities.

Since 1992, MMS has expended over $8.2 million for marine mineral environmental studies. Site-specific, interdisciplinary studies have been conducted in identified sand borrow areas to provide basic information on the biological characterization of resident benthic communities, as well as the evaluation of potential dredging effects on the local wave and current regime.

The primary purpose of MMS funded biological studies is to address biological concerns raised by the potential for adverse environmental impacts on marine life as a consequence of dredging sand on the OCS. In order to provide an initial characterization of benthic ecological conditions at offshore borrow sites prior to any dredging activity, the MMS has funded numerous site-specific studies. These studies have focused on the compilation and synthesis of existing oceanographic literature and available data sets which exist within identified offshore borrow areas, as well as biological field sampling surveys. Biological sampling surveys have included collecting traditional benthic grab samples, sediment profile camera images, and video sled footage. As a result, the MMS has been able to characterize and evaluate present benthic and pelagic communities within offshore borrow sites and address the potential effects of offshore sand dredging, including interpretations as to the potential rate and success of recolonization following cessation of dredging. In addition, the development of a time schedule of environmental windows that best protects benthic and pelagic species from adverse environmental effects has been examined.

Prior to dredging activity at an offshore borrow site, the potential for adverse changes in local wave and current patterns created by alterations in local bathymetry resulting from dredging operations must be assessed. Increased wave action after dredging offshore shoal areas may result in localized changes in erosional patterns and longshore coastal transport. A thorough evaluation of physical process changes must take into account the local current regime and the historical wind and wave climate.

Numerical wave modeling studies were initiated to examine potential alterations in the local wave field following dredging and the excavation of sand within identified borrow sites. In addition, modeling studies explored the potential for increased wave action after dredging and any resultant adverse localized changes in erosional patterns and longshore transport which might result in significant losses of beach sand after nourishment. These efforts have provided information to further explore the potential for changes in local sediment transport rates, as well as the cumulative physical effects of multiple dredging events.

Recognizing that the environmental effects of dredging op-

Table 2. *Possible conveyances of federal sand within the next 3 to 5 years.*

State	Locality	Cubic Yards Which Might Be Conveyed
Louisiana	Terrebonne and Barataria Basin barrier island restoration projects, including Whiskey Island west flank project and New Cut project (from Ship Shoal and other OCS sources)	10,000,000–20,000,000
Louisiana/Texas	Holly Beach, LA/Texas Beaches (from Sabine Bank)	4,000,000–6,000,000
Louisiana	Houma levee project (from Ship Shoal)	10,000,000
Virginia	Virginia Beach resort strip	1,000,000
Virginia	Dam Neck Naval Facility	1,000,000–2,000,000
New Jersey	Corsons Inlet	1,200,000
New Jersey	Harvey Cedars	7,400,000
New Jersey	Avalon-Stone Harbor	?
New Jersey	Monmouth-Sea Bright	?
New Jersey	Brigantine Beach	?
New Jersey	Manasquan-Barnegat Inlet	?
North Carolina	Dare County	?
Florida	East Coast (Jacksonville and counties south)/West Coast (Fort Myers area)	?

erations in many instances are similar for most areas, generic-type studies have been initiated to examine the effects of particular types of dredging operations on various aspects of the physical, chemical, and biological environments, and to develop or recommend appropriate mitigation, computer modeling, or monitoring techniques to alleviate or prevent adverse environmental impacts.

Because the OCS represents a future source of coarse sand and gravel for use as construction aggregate, MMS also has funded work in the United Kingdom to assess the potential for environmental damage associated with offshore aggregate mining in the event that such an endeavor is proposed for the U.S. OCS. These efforts have focused upon the extent and potential impacts associated with surface and benthic plumes generated during the aggregate operation, and the possible effects of these plumes on benthic organisms residing in the vicinity of dredging operations.

Environmental studies information is used by MMS analysts to evaluate the effects of specific proposed dredging operations, as required under current environmental laws and legislation. The results also are incorporated, as appropriate, in lease requirements and stipulations for the dredging of OCS sand.

FUTURE ENVIRONMENTAL STUDIES DIRECTION

Several overriding environmental issues will serve to steer the course of the MMS sand and gravel environmental program over the next several years. Site-specific studies in newly identified sand resource areas will continue to be conducted. One of the greatest challenges when determining the impact benthic communities face from dredging is the lack of baseline data and overall context in which benthic communities can be compared. Compilation and analysis of historical benthic data sets for various regions would provide baseline information for use in future biological studies and NEPA documentation. Biological data generated from site-specific benthic studies of potential sand resource areas would be more readily validated and useful in assessing variations in taxonomic assemblages resulting from offshore dredging operations (*i.e.* recolonization). Furthermore, the determination of regional assemblages, leading to a better understanding of the ecological relationship between the unique habitats of ridge and shoal features and resident benthic communities that live in those habitats, would provide a more complete analysis when evaluating the consequences associated with dredging for preparing environmental assessments. It is expected the information would provide a context in which environmental factors can be assessed qualitatively and described in detail.

Some identified sand borrow areas represent long-term sources of material that may be used on a continual basis. Sand sources that are used repeatedly may require ongoing biological and physical monitoring to alleviate adverse impacts to the surrounding marine and coastal environment. In particular, the continued, long-term use of submerged sand shoals on the OCS raises concerns relative to possible negative impacts to local biology and the physical environment. Sand shoals tend to be focal points for various fisheries, both recreational and commercial. Altering the physical characteristics of these areas (*e.g.*, grain size, morphology, wave and current regime) could be detrimental for various fish species. With the passing of legislation such as the Magnuson-Stevens Act, agencies such as the MMS are mandated to consider the effects of offshore dredging operations on fisheries. Areas on the OCS that are often selected as potential sand resource sites are in many cases used by fish as migration corridors, habitat for juvenile development, and spawning grounds. Migratory corridors are essential for many fish species as they play a distinctive role in their reproductive cycle. Activities that adversely influence these uses, through disturbances in migration patterns and changes in substrate, water quality, or acoustic parameters, can directly result in a decrease in fisheries. Potential adverse effects from offshore dredging activities should be evaluated for developing appropriate mitigation measures. Numerical wave modeling has, in some cases, shown that long-term excavation of shoals can cause adverse impacts to the wave climate and sediment transport regime, particularly during high-energy events. MMS must focus on engineering alternative for mining OCS sand borrow areas for avoiding or mitigating potential adverse effects on the biological and physical environment.

New advances in offshore dredging technology are leading to more environmentally sensitive offshore operations. Researchers are advancing our basic understanding of dredging procedures relative to physical and biological environmental impacts. Numerical modeling and measurement of physical processes, with the aim to predict behavior and minimize negative environmental effects associated with offshore excavation of sand, is ongoing. Research results provide the dredging industry advanced information to more effectively control the impacts of operations. In addition, environmentally-friendly engineering technologies currently used overseas are being contemplated for use in U.S. waters. To effectively manage the development of sand resources, the MMS must obtain detailed knowledge of the most current dredging technologies available for use.

SCOPE OF THE SPECIAL MARINE MINERALS ISSUE

In January 2002, MMS convened a symposium at the MMS Information Transfer Meeting in New Orleans, Louisiana to present the results of several recently completed studies. Those presentations form the basis for the technical papers included in this Special Issue. The papers describe site-specific and generic studies that provide information for lease decisions, including recommendations to protect marine and coastal environments as offshore dredging activities take place.

MMS operates under a mandate to ensure that OCS sand and gravel mining, proposed or conducted under Agency jurisdiction, does not result in adverse environmental impacts to the marine, coastal, or human environment. The combination of site-specific and generic studies provides a foundation on which the MMS can make sound environmental decisions relative to OCS marine mineral development.

Copies of all final reports for MMS sand and gravel en-

vironmental studies, plus supporting information on the MMS sand and gravel program can be accessed via the sand and gravel page on the MMS Offshore Program website.

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