

OFFSHORE ENVIRONMENTAL STUDIES PROGRAM

**FISCAL YEAR (FY) 2007-2009
STUDIES DEVELOPMENT PLAN
GULF OF MEXICO OCS REGION**

**U.S. Department of the Interior
Mineral Management Service
Gulf of Mexico OCS Region
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SECTION 1 PROGRAMMATIC OVERVIEW

1.1 Introduction to the Region

In managing Outer Continental Shelf (OCS) activity, the Minerals Management Service (MMS) has two core responsibilities, safe offshore operations and environmental protection. Our safety goal is to ensure incident free minerals exploration and development on Federal Offshore Leases. Our environmental responsibilities are to ensure that all activities on the OCS are conducted with appropriate environmental protection and impact mitigation.

The MMS New Orleans Regional Office conducts all leasing and resource management functions on the OCS for the Gulf of Mexico Region (GOMR) and the Atlantic Region OCS areas, a total of 415 million acres in seven planning areas (see map in Section 1.2). The GOMR OCS three planning areas along the Gulf Coast contain 43 million acres under lease (as of 03-31-2006). There are approximately 4,000 structures in the Gulf. Of those 4000 structures, only approximately 1200 are production platforms active in the search for natural gas and oil on the Gulf OCS (as of 04-03-2006); these contribute significantly to the Nation's energy supply.

The MMS Environmental Studies Program (ESP) was established in 1973 as a means to gather information to support decision making for offshore oil and gas leasing. The program (then under the Bureau of Land Management) evolved with changes in the geographic areas of concern, in environmental issues, and in study priorities and policies. In 1994, the MMS Atlantic OCS Regional Office was closed and its responsibilities transferred to the GOMR. In the GOMR, the ESP addresses issues from prelease through postlease operations. In the Atlantic Region, the ESP has been limited to prelease descriptive and process-type investigations since there has been no production in that area.

The Gulf of Mexico is anticipated to remain the Nation's primary offshore source of oil and gas. Initiatives to emphasize the use of "environmentally friendly" natural gas further promote the production from the Gulf's gas fields. Advances in offshore technologies (e.g., directional drilling; deepwater structures such as sub-sea completions, spar, and tension-leg platforms; sub-salt prospecting; three-dimensional geophysical profiling; and down-hole instrumentation) ensure that exploration and development will continue in the Gulf for decades to come.

In 1992 the MMS entered into a partnership with the Louisiana State University (LSU) to establish the first Coastal Marine Institute (CMI). This partnership was developed as part of an initiative to cultivate new State-Federal cooperative agreements on environmental and socioeconomic issues of mutual concern. These projects are designed to help answer questions regarding the potential impacts from oil and gas and marine minerals activities.

The establishment of the Biological Resources Division (BRD), a division of the U.S. Geological Survey, in 1996, provided the MMS with new opportunities for partnership in biological research. The BRD has procured and is conducting several studies for the GOMR. This partnership will continue and several projects are described in this plan anticipating the involvement of the BRD.

Because there has been a dramatic increase in deepwater oil and gas activity in the Gulf of Mexico, the MMS sponsored a deepwater workshop in April 1997. Conducted under a cooperative agreement with LSU, the workshop focused on physical oceanography and the environmental and sociological sciences. The recommendations and issues identified in the workshop proceedings (Carney, 1997) are being used to design the studies needed by the MMS in the preparation of environmental assessments, other NEPA documents, and deepwater regulations to oversee oil and gas activities. A follow-up workshop to discuss the results of these studies was held in May of 2002 (Schroeder and Wood, 2003). The information gathered since the first workshop was presented. Since most of the studies are still ongoing, it was determined that any planning for follow-up studies wait until the results and recommendations of the ongoing studies are available.

1.2 Map of the Planning Area



Figure 1. Map of the Planning Area

1.3 Projected OCS Activities

1.3.1 Gulf of Mexico Region

Since the GOMR is the most active OCS area, all activities associated with oil and gas exploration and production in U.S. are occurring here. These activities include leasing, exploration, development, removal of platforms, and laying of pipelines. The five-year (2002—

2007) environmental impact statement includes one lease sale per year in each of the central and western planning areas. The first lease sale in the eastern planning area since 1988 was held in December 2001. Two additional eastern planning area lease sales were proposed in the same area as Lease Sale 181. One was held in December 2003 and the second was held in December 2005.

Continuing the major expansion of the oil and gas industry in deepwater Gulf of Mexico, there were 27 new deepwater well startups and 10 new deepwater discoveries in 2005. As of March 2006, there were 118 deepwater hydrocarbon production projects on line. More than 980 exploration wells have been drilled in the deepwater Gulf since 1995. At least 126 deepwater discoveries have been announced since then. There were no major facilities that came online in 2005. Thunderhorse was planned to come online, but has been delayed because of engineering issues.

1.3.2 Atlantic Region

The last lease sale within the Atlantic Region occurred in 1983. On November 17, 2000, the interests in the last remaining eight natural gas and oil leases active in the Federal waters offshore North Carolina were relinquished. There are now no oil and gas leases in existence off the Atlantic Coast.

1.4 Identification of Information Needs

With the dramatic increase in offshore oil and gas activities in the deepwater of the Gulf of Mexico, environmental and socioeconomic information needs have increased as well. The GOMR has approximately 100 ongoing studies divided among all areas of interest. We are proposing studies in the following topics to meet our information needs to aid in future analysis within Environmental Impact Statements, Environmental Assessments, mitigations, and other requirements from the National Environmental Policy Act.

1.4.1 Physical Oceanography

The Region has already conducted numerous studies along the continental shelf. We held a workshop in September 2000 to plan the acquisition of information in deepwater. An exploratory study is under way to examine current structures in the central Gulf; this study is currently in the data analysis phase. A second study is underway in the western Gulf and a third in the Eastern Gulf. Results from these studies will be used to plan future research. An initial study to conduct process modeling using these data is proposed for FY 2007. We are also considering a workshop to be held shortly after data collection is complete.

Physical oceanographic processes do not stop at the Exclusive Economic Zone (EEZ) and a full understanding requires inclusion of information from Mexican waters. We are working with Mexican researchers to collect information in Mexican Waters. One current meter mooring is presently deployed in the central Gulf and a second set of moorings is deployed in the western Gulf.

1.4.2 Atmospheric Sciences

Two air emissions data collection activities are complete for the Breton Sound and for the entire Gulf. A modeling effort of SO₂ and NO_x is underway for Breton Sound. A repeat of the Gulfwide inventory is underway to coincide with data collection activities by other State and Federal agencies. We are proposing a study to determine if the data collected from the NASA Aura satellite data can improve air quality modeling for potential OCS impacts to adjacent land areas in the Gulf of Mexico. The data provides vertical profiles of ozone and its photochemical precursors for the Gulf of Mexico.

1.4.3 Fates and Effects

In the mid-1970s, the first major offshore environmental survey in the Gulf of Mexico was conducted in response to questions about the effects of oil and gas activities on the continental shelf. This study, "MAFLA," examined physical, chemical, and biological parameters along the Mississippi, Alabama, and Florida shelf. Portions of the Mississippi and Alabama shelf were revisited in the late 1980's for similar analyses as part of "MAMES." We are proposing a third visit to the same areas as examined under "MAFLA" with the intent to investigate the environmental effects of increased activities along the shelf over the past 25 years. A request for capability statements to study the effects of a synthetic-base drilling fluid spill-of-opportunity was recently published in the FBO. Should that study be successful, we are proposing a follow-on study to return to the same site to evaluate the recovery.

1.4.4 Biology

A major study of the deep-sea benthic community is nearing completion and is yielding exceptional information about the trends and distribution of benthic fauna in the deep Gulf. Data from this study will contribute to the understanding of density and types of organisms that live on the seafloor. The study also examined some of the processes that control the distribution of animals in the deep sea. Results from this study will be published by the end of 2006 and should give new insights into future directions for deep-sea benthic research.

Chemosynthetic communities have been studied extensively at depths less than 1,000 meters. Little is known about the extent of these communities at greater depths. A new study is beginning this year in coordination with NOAA's Ocean Exploration Program will investigate the distribution of both deep chemosynthetic communities and other hard bottom communities including deepwater corals at water depths below 1,000 m. The research submersible *Alvin* will be used in 2006 to explore some known as many newly discovered biological communities on the lower continental slope of the Gulf in 2006.

Expansive deepwater coral habitats have only recently been discovered throughout the world as well as in the Gulf of Mexico. A study of deepwater coral in the Gulf was initiated by MMS in 2003. The results from this study, also using a research submersible, will be published in 2006. Discoveries of this effort have led to a better understanding of deep coral distribution and new research directions for understanding this significant deepwater community type.

We continue to jointly fund a monitoring project of the Flower Gardens Banks with NOAA through the National Marine Sanctuary program. Because Hurricane Rita impacted the Sanctuary, monitoring was expanded to examine the effects and recovery of the corals from the storm.

1.4.5 Protected Species

Since the meeting between the SAC and SWSS PIs during the 23rd MMS information Transfer Meeting, many of the recommendations by the SAC had been implemented. In particular, SWSS was extended for two more years to allow for an extra field season and for more time for collaboration. Last summer, SWSS completed its field season and investigators are undergoing a year of analysis, synthesis, and integration leading to a Final Report and peer-reviewed publications. On June 2005, the G&G petition package was completed and submitted to National Marine Fisheries Service (NMFS). NMFS is in the process of securing funding for their NEPA document (EIS) which will be used in the MMPA rulemaking. The NMFS is issuing a Proposed Rule following MMS' submission of a petition package for the incidental-take of marine mammals and reptiles during the removal of OCS Platforms. NMFS hopes to publish the Draft Proposed Rule by the end of March, 2006.

1.4.6 Social Sciences and Economics

A workshop was held to provide guidance for socioeconomic studies planning for the next 5 years. The workshop began with the premise that much has been accomplished during the last decade of MMS socioeconomic research and that it is time to assess future directions of the program. The workshop sought advice, rather than consensus, on key questions, useful analytical approaches, and critical information needs. The two-and-a half day workshop was divided into three parts, a plenary session, breakout groups, and a summary session. The breakout groups focused on three topics, industry trends and dynamics, community-level impacts of oil and gas, and cultural impacts of oil and gas activity.

Several studies are proposed as a result of this workshop and continued evaluation of the program. These studies include an examination of state and local fiscal effects, an analysis of the oil services contract industry, and an assessment of the effects of the offshore oil and gas industry on urban communities in the GOMR.

Two archaeological resources studies have been proposed. We are proposing to groundtruth several targets in the Atlantic Region that have been identified in recent years through surveys to determine whether these targets are significant archaeological resources. With increased deepwater development, the Gulf study, which focuses on the discovery of historical documents pertaining to the colonial period, will provide a greater understanding of the historic shipwrecks in the Ultra Deep Water. Both of these studies will help fulfill MMS requirements under Section 106 of the National Historic Preservation Act.

1.4.7 Gas Hydrates

Interest in gas hydrates has waxed and waned over the past 30 years. With the spike in natural gas prices in early 2001 and interest in alternative fuel sources, interest is again focused on gas

hydrates. If hydrates do become an economically viable resource, environmental assessments will require an understanding of the location and distribution of the resource. The MMS joined the Chevron Texaco Hydrate Joint Industry Project, which will conduct research into gas hydrates in the Gulf of Mexico using funding from the Department of Energy (DOE). The DOE is funding \$11 million and industry is adding \$2 million to study and characterize gas hydrates in the Gulf of Mexico. The project is focusing on hydrates as a geohazard as well as a resource.

1.4.8 Other Studies

The Atlantic Ocean has a complex and diverse marine mammal community. Sea turtles are a major concern within the Atlantic Ocean as worldwide fisheries interactions and other potential impacts place individuals at risk. Under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA), these species are given particular legal status. The status of Atlantic protected species populations and any potential impacts that MMS regulated activities may have on these populations are significant program concerns. The proposed Atlantic workshop is to evaluate Atlantic Ocean protected species issues, review recent developments in research techniques, and set priorities for future information and research needs.

SECTION 2 PROPOSED STUDY PROFILES

2.1 Introduction

The following sections focus on the proposed studies for FY 2007 and FY 2008. Most of the ongoing studies in the GOMR can be found on the web at:

http://www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gom.html

Additional information about recent MMS funded deepwater research, in particular research cruises, can be found at:

<http://www.gomr.mms.gov/homepg/regulate/environ/deepenv.html>

2.2 Profiles of Regional Studies Proposed and on the FY 2007 NSL

Table 1. Gulf of Mexico Studies Proposed for the Fiscal Year 2007 NSL

Page #	Discipline	Title	Rank
13	MM	Workshop on the Status of Marine Mammals and Sea Turtles in the Atlantic Ocean	1
15	PO	North and Central Atlantic Information Resources: Data Search and Literature Synthesis	2
17	IM	Workshop on the Information Needs of Offshore Virginia	3
19	PO	Joint US-Mexico Physical Oceanography Workshop	4
21	PO	Ultra-Deepwater Circulation Processes in the Gulf of Mexico	5
23	HE	Continued Investigations of Northern Gulf of Mexico Deepwater Hard Bottom Communities with Emphasis on <i>Lophelia</i> Coral	6
25	AQ	NASA Aura Satellite Data—Background Ozone In The Gulf Of Mexico	7
27	SS	State- and Local-Level Fiscal Effects of the Offshore Petroleum Industry	8
29	SS	The Oil Services Contract Industry in the Gulf of Mexico Region	9
31	MM	Sperm Whale Acoustic Prey Study (SWAPS)	10
AQ = Air Quality FE = Fates & Effects HE = Habitat & Ecology IM = Information Management MM = Marine Mammals & Protected Species PO = Physical Oceanography SS = Social Sciences			

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Atlantic

Title: Workshop on the Status of Marine Mammals and Sea Turtles in the Atlantic Ocean

MMS Information Need(s) to be Addressed: The potential exploration and development of oil and gas resources in the Atlantic Ocean, as well as recent renewable energy and alternate use initiatives and projects, will require MMS to produce a variety of NEPA, ESA, MMPA and other environmental documents. There is a critical need for MMS to gather data and other information on marine mammals and sea turtles in the Atlantic Ocean, especially since the last MMS EIS dealing with this area was done in the late 1980s. Ample new information exists since that time and MMS needs to start collecting and analyzing this information as soon as possible. A workshop on marine mammals and sea turtles in the Gulf of Mexico proved very helpful in establishing the current body of knowledge and identifying data gaps that needed to be addressed. This proposed workshop is expected to provide similar information for the Atlantic Ocean that is necessary for the development of NEPA documents, biological assessments/evaluations for ESA biological opinions, MMS protected resources monitoring and mitigation measures, and the identification and development of priority study needs for marine mammals and sea turtles.

Cost Range: (in thousands) \$200-\$300

Period of Performance: FY 2007

Description:

Background: The Atlantic Ocean has a complex and diverse marine mammal community. Sea turtles are a major concern within the Atlantic Ocean as worldwide fisheries interactions and other potential impacts place individuals at risk. Under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA), these species are given particular legal status. The potential impacts of oil and gas activities are subject to thorough review by the National Marine Fisheries Service, Fish and Wildlife Service and Marine Mammal Commission. The status of Atlantic marine mammal and sea turtle populations and any potential impacts that MMS-regulated activities may have on these populations are significant program concerns. Previous MMS-sponsored workshops to address concerns and plan studies for determining potential impacts in the Gulf of Mexico proved very successful and provided invaluable input from a broad range of participants. The expected results of the proposed workshop are critically needed for use in MMS NEPA documents, biological assessments/evaluations for ESA biological opinions, the development of MMS protected resources monitoring and mitigation measures, and to identify and support priority study needs regarding marine mammals and sea turtles in the Atlantic Ocean.

Objectives: The objectives of the proposed Atlantic workshop are to:

- evaluate Atlantic Ocean marine mammal and sea turtle issues;
- review recent developments in research techniques and results;
- identify data gaps; and,
- set priorities for future information and research needs.

Methods: An Atlantic Ocean workshop is proposed to unite marine mammal and sea turtle researchers, representatives from Federal and State agencies, and other interested parties at a common meeting. The workshop will give MMS the opportunity to:

- learn from participants about the current status of the knowledge of marine mammals and sea turtles in the Atlantic Ocean;
- identify data gaps;
- become familiar with the latest research techniques that may be useful in addressing information needs;
- promote better communication between researchers, agencies, and the general public;
- promote rational discussions on human impacts and means to mitigate them; and,
- identify what actions MMS should pursue.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Atlantic

Title: North and Central Atlantic Information Resources: Data Search and Literature Synthesis

MMS Information Need(s) to be Addressed: The MMS will need updated and synthesized Atlantic OCS information on human and environmental aspects of the region, in order to meet its responsibility of ensuring that all OCS activities are conducted in an environmentally responsible manner.

Cost Range: (in thousands) \$240-\$360

Period of Performance: FY 2007-2009

Description:

Background: The northern U.S. Atlantic seaboard between Cape Hatteras, North Carolina, and Canada has not been developed for potential oil and gas reserves. This temperate region is distinctive for the Atlantic coastline. It has unique physical oceanography, physiography, and zoogeography; several valuable fisheries; and characteristic weather patterns. It harbors a suite of protected coastal and offshore marine organisms including sea turtles, birds, fishes, and marine mammals, many of which are considered endangered or threatened.

The last synthesis of physical oceanographic information in the US Atlantic coast conducted for MMS was in 1992 and indicated information gaps, including the main forcing of the mean southerly flow of the shelf and its variability, and the cross-shelf transport of water. Given the date of the review, and the certain advance in knowledge since then, a synthesis of knowledge is highly recommended, especially given our limited familiarity with this area. The MMS sand and gravel program has collected nearshore information during the 1990's and beyond, which could be incorporated into the synthesis.

Although MMS has conducted an extensive amount of social science research in the GOMR, much of this information cannot be easily transferred to the Atlantic coastal region. The Atlantic coastal area is characterized by high-density, multicultural, urban, and maritime populations. Many communities in the region have very limited or no history of offshore energy production. The literature synthesis and baseline data will help in understanding these communities and in predicting how they will be able to respond to potential renewable and alternative energy development.

In the Atlantic Region, the ESP has been limited to prelease descriptive and process-type investigations in recent years since there has been no production in that area. The recent surge in energy prices and alternative energy initiatives may result in future leasing activity in the Atlantic Region.

Objectives: The objectives of the study are:

- to develop comprehensive information on the human and environmental aspects of the region, and
- to update the understanding of the ecological communities, the dominant oceanographic and other processes that drive the shelf and deep-sea ecosystems, and the potential sensitivities of the area.

Methods: The data search and synthesis will be a comprehensive search and integration of existing environmental and socioeconomic information for the region. The relative contributions of physical oceanographic processes to cross-shelf transport will be evaluated, as will the contributions of buoyancy and meteorological forcing to seawater transport. Period of performance is expected to be 24 months, with a deliverable report after 20 months.

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ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Atlantic

Title: Workshop on the Information Needs of Offshore Virginia

MMS Information Need(s) to be Addressed: The MMS will need to conduct a workshop on the information needs on environmental and sociological issues for offshore Virginia, in order to meet its responsibility of ensuring that all OCS activities are conducted in an environmentally responsible manner.

Cost Range: (in thousands) \$250-\$350

Period of Performance: FY 2007

Description:

Background: The areas in Virginia being considered for offshore development are on the OCS, continental slope and continental rise. The areas are located about 50 miles offshore and beyond in the federal Exclusive Economic Zone. The area is in the United State's Minerals Management Service (MMS) Mid-Atlantic Planning Area. This area has been prohibited from development since 1990 through congressional and presidential moratoria. The Minerals Management Service manages OCS natural gas and oil development under 5-year leasing plans. The MMS is now developing the 2007-2012 leasing plan.

Most environmental impacts from OCS development and production are likely to be temporary and would be mitigated. These include the following: water quality impacts from debris, oil, and other contaminants from work boats and equipment; acoustic impacts to marine mammals and fish; direct impacts to marine mammals and reptiles from vessel strikes; and possible direct habitat disturbance to the submerged land where the activity occurs, including impacts to submerged aquatic vegetation beds, oyster reefs, and other shellfish habitats.

The socioeconomic impacts of the production and development of offshore resources may affect coastal localities. The industry requires construction, transportation, communications, and other support services. These are likely to have positive impacts on local economies. They also could affect local governments, shipping (both military and civilian), tourism, and fishing industries.

A workshop will allow Virginia to understand the impact from OCS production development. It would serve as the first step for Virginia in its involvement in the decision-making process for any OCS development through the National Environmental Protection Act (NEPA) environmental impact review and the Coastal Zone Management Act consistency review.

Objectives: The objectives of this proposed workshop are to:

- to review the environmental and socioeconomic issues for offshore Virginia;
- develop recommendations for a coordinated plan of environmental and sociological research for offshore Virginia; and
- explore the coordination of potential interdisciplinary research programs.

Methods: The workshop will consist of technical presentations, breakout sessions, informal discussions, and a final, closing plenary session. The proposed schedule is: a plenary session of one day for reviewing state of knowledge; and two days of breakout sessions. The final plenary session of one day will be subdivided into a half day for groups' summaries presentations and half day for discussions and closing.

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ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): US and Mexico Gulf of Mexico Deepwaters

Title: Joint US-Mexico Physical Oceanography Workshop

MMS Information Need(s) to be Addressed: The results of the workshop will help MMS plan the next phase of the physical oceanography deepwater program for the GOM OCS. Also, the workshop will streamline the coordination of studies with Mexican researchers; and explore the coordination of interdisciplinary research occurring in both sides of the border.

Cost Range: (in thousands) \$200-\$300

Period of Performance: FY 2007-2008

Description:

Background: Deepwater activity in the GOM OCS continues and production from these leases is replacing loss production from shallower areas. Concurrently, leasing and exploration in water depths of over 1,500 m, even near the US-EEZ border, is the new emerging frontier for MMS. In Mexico, Petroleos Mexicanos (PEMEX) plans to start production in the continental slope (depths > 500 m) by 2010. To this end, Mexican officials have started acquiring oceanographic data. For its part, the MMS has nearly completed an ambitious program consisting of historical data synthesis, three numerical modeling studies, and seven field studies of circulation of the deep Gulf in US and Mexican waters. Thus, both research groups are at a stage where updating of their programs is needed and convenient. Aside, given our mutual interests in safe development of oil and gas resources, it seems that cooperation between both nations needs to increase. Finally, this workshop builds in past joint ventures such as the very successful Yucatan Channel current study funded by Industry and the NAVY.

Objectives: The objectives of the workshop are to:

- to review the physical oceanography knowledge in US and Mexican deep waters;
- develop recommendations for a coordinated plan of physical oceanographic research in US and Mexican waters; and
- coordinated physical oceanographic research and interdisciplinary research programs between US and Mexican researchers.

Methods: The workshop will consist of technical presentations, breakout sessions, informal discussions, and a consolidating or wrapping plenary session. A small bi-national planning group will be formed to select the Chair(s) and jointly finalized the scope, logistic, structure, and invited talks of the workshop. Initial topics to be address include, but are not limited to topographic effects on circulation, surface-bottom coupling, driving forces, and numerical modeling needs. Plenary talks should address what we have learned, information gaps and needs, coordination among researchers, and should be given by active researchers in the GOM.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Gulfwide

Title: Ultra-Deepwater Circulation Processes in the Gulf of Mexico

MMS Information Need(s) to be Addressed: The MMS is responsible for assuring that the exploration and production of oil and gas reserves in the OCS are conducted in a manner that reduces risks to the marine environment and to the welfare of humans and organisms that depend on it. As exploration and production continue to move into deeper waters, currents in the ultra-deep GOM are of continuing interest to the MMS. Model results and analysis from this study will provide better understanding of circulation processes in deep and ultra-deep water that will be useful for the preparation of future NEPA documents. The understanding of ultra-deep circulation processes that this study will provide to MMS may also contribute to the data interpretation and usefulness of biological or chemical deepwater studies.

Cost Range: (in thousands) \$575-750

Period of Performance: FY 2007-2009

Description:

Background: Seawater circulation processes in the GOM take place within what has been described as a two layer system. Little dynamic interaction is thought to occur between upper layer processes associated with the top 1,000 meters of the water column, and lower layer processes that occur from about 1,000 meters to the seafloor. Upper layer processes in the GOM include the Loop Current, Loop Current rings, filaments, and smaller, peripheral frontal eddies associated with the Loop Current and Loop Current rings. Topographic Rossby waves are thought to predominate in the deep and ultra deep (>1524 m) waters of the lower layer, but here circulation processes are less well understood. The available results support the presence of deep water eddies and vertical exchange, and a mean cyclonic (counter clockwise) deep water circulation regime.

New current data are becoming available from ongoing studies conducted by the MMS GOMR, and these data provide new opportunities to investigate circulation processes in the ultra-deep GOM. The *Exploratory Study of Deepwater Currents in the Gulf of Mexico*, the *Survey of Deepwater Currents in the Northwestern Gulf of Mexico*, the *Survey of Deepwater Currents in the Eastern Gulf of Mexico*, and other ongoing deepwater data collection will provide a large database of lower layer currents and temperatures. Data analyses associated with these studies will provide information about physical oceanographic conditions and processes that occur in the lower layer in deep and ultra-deep water regions of the GOM. Process modeling studies will complement and extend process information obtained from these data analyses. Future hindcast studies could provide a comprehensive current field in ultra-deep regions, and prior high quality process modeling can result in improved hindcast simulations.

The MMS GOMR has recently conducted and completed a suite of process modeling studies that have greatly enhanced our understanding of physical oceanographic processes on the slope and rise in the northern GOM. Similarly, the benefit of new ultra-deep data to the MMS can be substantially enhanced and complemented by ultra-deepwater process modeling studies which can provide coverage in sufficient detail. Modeling studies will allow the detailed examination of processes by means of numerical experiments that are not possible in data studies.

Objectives: To advance our understanding of the physical conditions and processes from 1,000 meters depth to the seafloor in the ultra-deep GOM, using numerical modeling techniques in conjunction with the large quantities of physical oceanographic data recently collected by MMS. In particular,

- to examine circulation processes and energetics from approximately 1,000 meters depth to the seafloor in ultra-deep GOM waters. This includes examination of topographic Rossby waves, as well as examination of eddies and their sizes, and other processes that may or do exist below 1,000 meters depth in the ultra-deep regions of the GOM;
- to examine ultra-deep vertical as well as horizontal transport in the Gulf and the mechanisms and processes which characterize it, and to examine the degree to which lower layer and upper layer circulation interact; and
- to address the nature of interactions of lower layer circulation with realistic ultra-deep bottom topography, and effects of these interactions, including bottom dissipation and steering, on ultra-deep circulation processes.

Methods: The model must be a proven numerical ocean circulation model based on assumed physics, of sufficiently high horizontal and vertical resolution to resolve eddies as small as 20 km in diameter. Model input forcing shall include at a minimum surface wind derived from available wind data, river runoff, surface heat flux, and the Loop Current. The computational domain should include the GOM from the sea surface to the seafloor. Deep currents measured in current MMS studies must be used heavily in this modeling effort. Other data are available and should be used as well. Throughout the study, the process modeling shall be guided by available data. The modeling team may also choose to employ data for boundary conditions, initial conditions, and other uses consistent with the objective of providing a realistic simulation of ocean circulation processes within the computational domain. Digital deliverables to be provided to MMS will include model output in the format specified, peer reviewed publications, an ITM presentation, and a final report of findings. This final report must include an *extensive discussion and interpretation* of study results, including lower layer circulation processes and energetics in the ultra-deep GOM, vertical and horizontal transport and processes, and interaction of lower layer circulation with circulation in the upper layer and with bottom topography. The discussion and interpretation of these modeling results shall provide new information and insights obtained from analysis of model output in order to realize each of the above objectives and to fulfill the needs of MMS.

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ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Western and Central

Title: Continued Investigations of Northern Gulf of Mexico Deepwater Hard Bottom Communities with Emphasis on *Lophelia* Coral

MMS Information Need(s) to be Addressed: Knowledge of the distribution and sensitivity of unique biological habitats in deep water is necessary for management decisions. Study results will help to further refine current mitigations and need for avoidance of hard bottom areas in deepwater.

Cost Range: (in thousands) \$1,520-\$2,280 **Period of Performance:** FY 2007-2010

Description:

Background: It is well known that there are some locations with significant areas of hard bottom in the deep Gulf of Mexico, particularly associated with the tops of salt diapirs. These hard bottom areas are generally created through biogenic precipitation of carbonate by chemosynthetic bacteria. Carbonate deposits can subsequently become exposed above surrounding slope sediments providing substantial substrate for attached animal communities to develop. These areas are well represented on 3D seismic surface anomaly geophysical maps used during the biological review process of potential impacts from proposed drilling operations or pipeline installations. An initial study has demonstrated the presence of extensive deepwater coral communities in the deep Gulf of Mexico but information is lacking for informed decisions regarding distribution and sensitivity to impacts.

The previous *Lophelia* study, *Characterization of Northern Gulf of Mexico Deepwater Hard Bottom Communities with Emphasis on Lophelia Coral (Lophelia I)* was recognized as an important step in gaining knowledge of previously unknown sensitive biological features in the deep Gulf of Mexico. This study and final report will be completed in late 2006. Deepwater corals have become an increasingly significant habitat and area of study throughout the world.

The initial study, *Lophelia I* has proven to be very enlightening and successful as far as it was capable of progressing with the field time allowed by that project's budget. A draft final report from this project is expected in 2006. This study was the first in the deep Gulf of Mexico to specifically investigate hard bottom coral communities. "*Lophelia I*" had a relatively modest budget considering it included manned submersible research over large areas of the Gulf of Mexico. Submersible dive days for this initial study were limited to only seven in 2004 and just four days in 2005.

Significant unanswered questions and new directions have become evident from the results of the initial *Lophelia I* study. Focused studies and process-oriented research will be necessary to further develop an understanding of the distribution of deep coral habitats. Of particular significance is determining the probability of where high-density coral communities will be found on exposed hard bottom substrate.

Objectives: The purpose of this follow-up study is to focus on remaining questions that will define environmental conditions that result in the observed distribution of significant high-density hard bottom communities that are sensitive to impacts from oil and gas development activities (especially extensive areas of *Lophelia* coral).

Methods: Similar to the previous *Lophelia* I study, this project will require the use of a manned submersible for the fine scale observation and sample collections required to describe new, high-diversity biological communities. In addition, it is expected that a number of collaborations will continue with USGS and some complimentary elements of this project will be conducted by investigators from various USGS/BRD locations.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Gulfwide

Title: NASA Aura Satellite Data - Background Ozone in the Gulf of Mexico

MMS Information Need(s) to be Addressed: MMS has a regulatory responsibility to perform air quality assessments describing impacts from offshore oil and gas operations in onshore areas. This proposed study would enhance air quality model performance by providing air quality models with improved initial conditions, which in-turn, could provide more accurate modeled estimates for onshore ozone impacts due to oil and gas sources.

Cost Range: (in thousands) \$96-\$144

Period of Performance: FY 2007–2008

Description:

Background: The Minerals Management Service (MMS) is the regulatory authority for oil and gas operations in the central and western Gulf of Mexico. Air quality assessment, specifically potential onshore ozone impacts due to oil and gas operations in Federal waters, is part of MMS' regulatory responsibility. Since air quality models are used to assess potential onshore ozone impacts, it is extremely important that the models provide the most accurate ozone impact estimates possible. Since there are no accurate Gulf of Mexico background measurements for ozone and precursors, air quality models must use crude estimates for air quality model inputs. Poor estimates for ozone/precursor background concentrations can contribute greatly to errors in the predicted ozone for the Gulf of Mexico, and when these pollutant concentrations move to adjacent land areas, can contribute to erroneous assessments of air quality impacts from OCS sources. This proposed study will evaluate the viability of NASA satellite data to enhance air quality model performance by providing improved air quality background observations over the data sparse regions of the Gulf of Mexico.

One of the instruments on NASA's Aura spacecraft is the Tropospheric Emission Spectrometer (TES), which is a high-resolution infrared-imaging spectrometer. Observations from the TES offer the potential for improved understanding of long-term variations in the quantity, distribution, and mixing of minor gases in the troposphere, including sources, sinks, troposphere-stratosphere exchange, and the resulting effects on climate and the biosphere. The TES instrument provides vertical profiles of ozone and its photochemical precursors for all ocean areas, including the Gulf of Mexico.

Objectives: The objective of this study is to determine if the data collected from the NASA Aura satellite data can improve air quality modeling for potential OCS impacts to adjacent land areas in the Gulf of Mexico.

Methods: Through data extraction, evaluation and modelling tasks, this Project will provide an assessment of the viability of NASA Aura satellite data to improve air quality model

performance due to enhancements to the air quality model initial conditions. The proposed effort will consist of two major elements:

- extracting and evaluating NASA Aura satellite air quality data; and
- performing sensitivity tests with the Community Multi-scale Air Quality Model (CMAQ) air quality model to assess the merit of the proposed strategy.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Areas: Eastern, Central, and Western

Title: State- and Local-Level Fiscal Effects of the Offshore Petroleum Industry

MMS Information Need(s) to be Addressed: The fiscal consequences of the OCS program are the most direct and significant way in which the program affects states and communities. These effects are largely shaped by the interaction of federal law and each state's revenue and allocation mechanisms. Currently, MMS lacks a systematic understanding and analysis of fiscal effects at state and local levels. This study will strengthen agency assessments by addressing this oversight, support our continued improvements to the projections of the indirect effects of the program, and provide information to states, localities, and other stakeholders concerning the cumulative effects of the program.

Cost Range: (in thousands): \$250-300

Period of Performance: FY 2007-2009

Description:

Background: The evaluation of fiscal effects is an important aspect of socioeconomic assessment. The tax receipts and other revenues generated by OCS-related activities are a major program benefit to counties/parishes, states, and the nation. The fiscal consequences of OCS-related demands on public infrastructure and services are also a program burden to counties/parishes and to states. Fiscal effects are the result of OCS-related activity (e.g., leasing, rig fabrication, oil production, and transportation). For example, the growth of the industry, the distribution of its onshore activities, and its cyclic nature all affect its fiscal consequences. However, fiscal effects are largely determined by federal, state, and local policy and law. For example, how much tax revenue is collected, and by what jurisdictions, is defined by law and tax law has both short- and long-term consequences. Who benefits from these tax revenues is also determined by law. They may accrue to the nation or a state (in the form of general revenues), or to a more limited user group (coastal recreation) or specific jurisdiction (e.g., county school district). Since both the collection and dispersal of OCS-related revenues are shaped by fiscal policies interacting with the operations and distribution of the industry, the fiscal consequences of the program vary greatly from state to state and community to community.

Objectives: The objectives of this study are to:

- document and assess the fiscal consequences of the petroleum industry on Texas, Louisiana, Mississippi, and Alabama;
- assess the OCS program's contributions to these effects (including Federal transfers);
- identify the fiscal implications of the program on relevant jurisdictions within each state by analyzing differences in benefits and their distribution among the states and relevant jurisdictions; and

- develop a methodology that can be used in future assessments of fiscal effects.

Methods: Fiscal effects are complex and therefore are extremely difficult to measure and assess. This study will use available data sources and develop a standard technique to identify and/or estimate revenues to local jurisdictions, Texas, Louisiana, Mississippi, Alabama, and the nation and to track their disbursements. The study will identify and assess the factors that affect revenues and their magnitude and disbursement including those related to industry activity (e.g., business cycle) and to governance (e.g., taxation strategies). The study will select a sample of relevant jurisdictions (parishes, counties, municipalities, and special districts) within each state that are fiscally impacted by the industry and detail these impacts. These case studies will be examined to assess fiscal effects at the regional level.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Eastern, Central, and Western

Title: The Oil Services Contract Industry in the Gulf of Mexico Region

MMS Information Need(s) to be Addressed: The information will be used for analyzing and discussing employment impacts to support GOMR Environmental Impact Statements. To date, the problem of defining this sector has limited our ability to assess the industry, understand its distribution, and project its economic effects. Information collected may also be used to improve the existing economic impact model through a better understanding of how to allocate contractor support expenditures.

Cost Range: (in thousands) \$100 - \$125

Period of Performance: FY 2007 -2008

Description:

Background: The oil service industry is distinct from the integrated and independent oil companies. Contractors perform a wide variety of tasks such as drilling, processing drilling mud, well service and workovers. They engage in rig, pipeline, and platform construction. Oil service industry contractors account for roughly 60 percent of all direct offshore employment in the Gulf of Mexico, yet the Agency has only a limited understanding of this very important industry group. In recent years, this group has become even more important as more and more functions are contracted out – a trend that is likely to continue in the future.

Objectives: The purpose of this study is to develop an understanding of the oil services contract industry in the GOMR. The Agency is particularly interested in gaining a better understanding of industry expenditures and employment in this area, including how they are distributed throughout communities in the GOMR. The study will identify the types of functions that are being contracted out, the characteristics of the firms that are contracting out the functions (i.e. discuss differences between majors and independents in using contract labor), and the characteristics of the service contractors. The study will also examine how the role of contract labor in performing the different functions has changed over the past decade.

Methods: The methodology will consist of a literature review, data collection from public sources, discussions with key industry representatives, and analysis and synthesis of the collected data and information. The study will update and significantly expand the data and information collected in earlier MMS studies (MMS 86-0016 and MMS 93-0007).

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Eastern, Western, and Central

Title: Sperm Whale Acoustic Prey Study (SWAPS)

MMS Information Need(s) to be addressed: The potential acoustic disturbance resulting from seismic industry activities in the GOM is a controversial issue. The potential effects of seismic exploration on marine vertebrates (cetaceans and sea turtles) and their prey species are largely unknown. The most recent National Marine Fisheries Service (NMFS) Biological Opinions (2002, 2003) for lease sales in the GOM have included recommendations that “MMS should support investigations into the effects of seismic noise on the distribution of cephalopods and fish (i.e., sperm whale prey items) near seismic vessels, including diel vertical migration, startle effects, distribution and abundance.” The possible impacts of seismic noise on prey species (e.g. squid) are an information gap that may influence future mitigation.

Cost Range: (in thousands) \$450-\$650

Period of Performance: FY 2007-2010

Description:

Background: While the potential impacts of seismic exploration on marine vertebrates are poorly understood, even less is known about seismic impacts to the marine invertebrate community. It is assumed that sperm whales are not randomly distributed within the ocean environment and are concentrated in areas with increased prey abundance. Negative impacts to prey populations may result in changes in sperm whale abundance, distribution and reproductive success. The Sperm Whale Seismic Study (SWSS) is collecting data on sperm whale biology, habitat use, and the possible effects of seismic airguns using controlled exposure experiments (CEEs). While these data will add to the knowledge base of GOM sperm whale populations, they will not provide information about how sperm whale distribution is related to the relative abundance and distribution of their primary prey items (cephalopods). Squid are the primary prey item in the sperm whale diet; however previous investigations have used stomach contents and/or fecal analysis for prey determination. The ability to accurately sample squid in a deep-water environment is severely limited by current methodology. The most common technique involves the use of trawls. Collections using trawls typically result in few medium to large size squid which are able to avoid capture. Identification of squid stocks with acoustic methods (developing a squid signature) would allow for rapid surveys of large areas in the GOM. These data could then be correlated with both large scale sperm whale distributions in the gulf as well as with the small-scale feeding movements of individual whales. It’s been suggested that when prey is abundant, sperm whales swim in more of a zig-zag pattern over small areas, while when prey is scarce they swim in more of a straight line. However, testing this is currently impossible due to the lack of information about squid stocks in the GOM.

Objectives:

- To determine the potential impacts of seismic activity on sperm whale prey (e.g. squid and fish) by investigation of prey abundance, distribution, startle response and diel vertical migration.
- To determine the relationship of sperm whale distribution, movement, and relative abundance to the distribution of squid prey.

Methods: Sperm whales will continue to be tracked and monitored as part of the SWSS studies. Characterization of an acoustic signature for squid will be determined using a variety of acoustic techniques including echosounders and the BIOMAPPER II. These data will then be “ground-truthed” using deep water trawls, jig-sampling, and autonomous, slow-falling camera packages. Once it has been determined that squid can be accurately detected using acoustic survey methods, squid sampling will occur in areas with sperm whales present in order to determine the potential relationship of squid prey on sperm whale distribution. Small-scale movements of individually tagged (either D-tag or S-tag; under separate funding) whales will be monitored while squid acoustic sampling occurs to determine if feeding strategies are related to prey abundance. Acoustic sampling of squid will also occur concurrently with seismic exploration to determine if squid are showing any response (either positive, negative, or neutral) to seismic activity.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Eastern

Title: Dynamics of the Loop Current in US Waters

MMS Information Need(s) to be Addressed: The results of the study will help improve forecasting of eddy shedding by the Loop Current. This improved forecasting capability will be used by MMS and Industry to prepare for and avoid high currents induced by warm eddies during exploration and production activities. Avoidance actions directly reduce downtime, losses or accidental releases, and fatigue, all which are of concern to MMS.

Cost Range: (in thousands) \$4,400 -\$6,600 **Period of Performance:** FY 2008-2013

Description:

Background: The most influential driving force in the GOM is the Loop Current (LC). The Loop is the main source of water for the Gulf, transporting relatively warm and salty waters from the Caribbean Sea at a rate of 25-30 Sv. During its north-south incursion cycle, the Loop Current sheds large warm or anticyclonic eddies (diameters of 200-400 km) that propagate to the western Gulf at speeds of 4 to 8 km·day⁻¹. This strong jet, with surface velocities on the order of 150 cm·s⁻¹ dominates the mesoscale variability of the Gulf, especially in deep waters where it is believed to influence the current field through frontal eddies, and the source of Topographic Rossby waves and near bottom-trapped eddies. This strong current is also the beginning of the Gulf Stream Current, which is part of the meridional circulation of the Atlantic Ocean. Despite these superlatives, very few studies of this potent current have been completed in the past. Most of our current knowledge of this current is through indirect methods or hydrographic surveys, satellite studies, numerical modeling, and few moorings (~ five) placed on this feature. Based on statistical analysis of satellite data, we know that it penetrates into the northern Gulf in a nearly chaotic mode at intervals of 0.5-18 months. Once it reaches its most northerly position, it breaks and sheds a large warm Loop Ring.

Recently, strong and nearly barotropic currents have been observed below mid-depth in depths > 2000 m. These strong currents are associated with large bathymetric gradients and the presence of topographic Rossby waves with periods of 10 to 30 days. Also, strong currents are associated with near bottom eddy-like features in the neighborhood of the steep topography. Recent observations and ray tracing techniques suggest that Rossby waves originated near the Loop Current in the eastern Gulf, but we lack unequivocal data on this and even the mechanism(s) to generate these Rossby waves.

Objectives: The purpose of this study is to make observation inside the Loop Current for a period of three years and to analyze the data of ocean currents to learn about the dynamics of this current. The data collected will be used to understand and improve predictions of the shedding mechanism and coupling between surface and bottom flows. Furthermore, the scope and objectives will be revised using recommendations from the US-Mexico joint workshop.

Methods: Standard oceanographic methods (moorings, PIES, and hydrographic surveys) will be employed to collect ocean current data and to analyze the resulting data to extract as much information and knowledge as possible from it. Satellite data will be needed to provide the synoptic view plus data on other aspects of the Loop Current available only through this technology. The possibility of extending the array into Mexican waters and cooperating with their researchers will be explored during the final planning stages of this study. The performance period will be divided into three years of field work and data collection, and two years for data analyses and report completion. The MMS has a sizable inventory of equipment which resulted in substantial savings to the estimated cost.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Eastern, Central, and Western Gulf of Mexico, North, Mid, and South Atlantic, and the Straits of Florida

Title: Alternative Energy Project Scenarios for the Planning Areas of the Gulf of Mexico and Atlantic Regions

MMS Information Need(s) to be Addressed: This will be the first MMS effort to collect economic information on alternative energy projects likely to take place in the planning areas of the Gulf of Mexico and Atlantic Regions. The information will be used for developing sections of Environmental Impact Statements, particularly for analyzing and discussing the economic impacts of alternative energy projects. Information collected may also be used to expand the Agency's existing economic impact model to add the capability of analyzing alternative energy projects.

Cost Range: (in thousands) \$200 - \$225

Period of Performance: FY 2007 -2008

Description:

Background: The Energy Policy Act of 2005 grants MMS new responsibilities over Federal offshore renewable energy and related-uses of the OCS. Under this new authority, MMS also becomes the lead Federal agency of permitting and regulatory oversight of the Cape Wind project, offshore Nantucket, Massachusetts, and any other projects already submitted to the U.S. Army Corps of Engineers. In light of this new responsibility, MMS needs to begin collecting the data and information necessary to analyze the economic impacts of these new types of projects.

Objectives: The objective of this study is to gain a better understanding of the capital and labor requirements of the alternative energy projects most likely to take place in the planning areas of the Gulf of Mexico and Atlantic Regions. These renewable energy projects include wind, wave, or solar energy on offshore lands, and other projects that make use of existing oil and natural gas platforms. For each sample project, the types of available technologies that could be used will be examined, including different capital input options, where the capital equipment is produced (supplied locally, within the U.S., or foreign-produced) and what it costs (capital expenditures), the amount of labor and types of labor skills required, etc. for each stage of the project (construction, operation, decommissioning). The study will also examine the energy and public infrastructure investments that would be needed to support the projects.

Methods: The methodology will consist of a literature review, data collection from public sources (including information on existing projects in other countries), discussions with key industry representatives, and analysis and synthesis of the collected data and information to develop different sets of likely project scenarios.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Atlantic-wide

Title: Monitoring of Industry Compliance, and National Register of Historic Places Evaluations of Submerged Sites on the Atlantic Outer Continental Shelf

MMS Information Need(s) to be Addressed: This study will provide information on potential archaeological resources by groundtruthing unidentified sidescan sonar targets. Information obtained will assist the MMS Archaeology Unit to determine if targets identified for avoidance are actually associated with archaeological resources. It will also provide information on the size of expected debris fields associated with historic shipwreck sites. This information will be used to develop avoidance criteria for archaeological sites on the OCS. This study will help fulfill MMS requirements under Section 106 of the National Historic Preservation Act.

Cost Range: (in thousands) \$180-\$270

Period of Performance: FY 2008

Description:

Background: Federal agencies have, under Section 106 of the National Historic Preservation Act, the responsibility to consider the effect of agency actions on significant archaeological resources. While MMS has adhered to Section 106 by requiring applicants to conduct remote sensing surveys and avoid potential targets, no testing has been performed to ascertain the effectiveness of this requirement or to determine if the remote sensing targets that are selected have any real archaeological significance. It has been over 25 years since any type of archaeological study has been completed on the Atlantic OCS. The last study was prepared in 1979 for the Bureau of Land Management by the Peabody Museum. Since 1979 there have been several significant archaeological discoveries off the Atlantic coastline, including historic shipwrecks and submerged prehistoric sites. With recent interest in alternative energy sources and possible new leasing activity in the Atlantic Region, development in this area will increase.

A similar study of this type is nearing completion in the GOMR OCS and was successful in investigating 14 unidentified sidescan sonar targets that had been recommended for avoidance by industry-related activities. Of these 14 targets, five of these sites were identified as historic shipwrecks, and three will be nominated to the National Register of Historic Places. Additionally, while another recent GOMR OCS study (Church, et al: in print) has developed a formula for determining appropriate avoidance distances for historic 20th century shipwrecks in deepwater, no such formula has been attempted for historic shipwrecks in water depths less than 130 fsw. The knowledge gained from this study may allow the MMS to be less restrictive on development by more accurately identifying how significant resources appear in the remote sensing record and determining a more realistic avoidance radius for these resources.

Objectives: The objectives of the study are to ground-truth, positively identify, and assess the National Register status of eight to fifteen selected targets identified in applicant-submitted remote sensing surveys and to evaluate associated debris fields to develop a model of appropriate avoidance criteria.

Method: Potential targets have been reported to the MMS through recent pipeline, sand and gravel, and alternative energy survey activities. The objectives of the study will be achieved through investigating a list, developed by MMS archaeologists, of potential sites that will be provided to the contractor. Test sites will be selected from a list that has been developed in recent years of targets that have been recommended for avoidance. The criteria for selection will include the appearance of an acoustic image, the association of magnetic anomalies, and the report of an historic shipwreck in the target vicinity. Testing would be performed by marine archaeologists applying a variety of techniques including remote sensing, diving, and ROV inspection. The projects will likely consist of extensive photographic documentation and limited excavation and artifact collection for identification purposes, as well as historical research. These projects will not hamper the applicant's ability to complete their projects since potential targets will continue to be avoided until such time as they can be tested for significance. This project would compliment similar efforts in the GOMR OCS to assess remote sensing targets that appear likely to be related to an archaeological site.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Western and Central

Title: Deepwater Artificial Reef Effect II (DARE II)

MMS Information Need(s) to be Addressed: There is a need to understand the ecological role of deepwater platforms or other deepwater oil and gas related structures serving as artificial reefs in the Gulf of Mexico in order to make decisions regarding decommissioning. Results from this study would directly address MMS Strategic Initiative #7, to develop and implement a plan for decommissioning OCS facilities in an environmentally sound manner in the deepwater Gulf of Mexico. For the next five years, a total of approximately 22 structures are expected to be decommissioned each year in water depths below 200 m.

Cost Range: (in thousands) \$960-\$1,920

Period of Performance: FY 2008-2010

Description:

Background: Oil and gas exploration and development activities continue to move into deeper and deeper water. Recent discoveries of oil and gas now include ultra deep water areas of the Gulf of Mexico in depths from over 5,000 to 10,000 of water. In the near future, decisions will be required for the removal of structures located in water depths beyond the continental shelf. Current guidelines outlined in 30 CFR Part 250.1728 allow the MMS Regional Supervisor to approve alternate plans for removal of structures when the water depth is greater than 2,624 ft (800 m). Options for removal at shallower depths have previously relied on the concept that the structure left behind would serve a positive fisheries enhancement or other beneficial environmental function. The MMS now has a direct need for information that will help describe any significant ecological role (if any) that man-made structures may have in deepwater of the Gulf of Mexico. A recent study "*The Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: A Pilot Study of the Artificial Reef Effect in Deepwater*" first approached this subject. This project was in effect DARE I. Remarkable discoveries were made on some of the shipwrecks investigated during this project. One wreck was particularly significant, the *Gulfpenn*, sunk in 1942, provided a known recruitment time of 62 years. Several large colonies of *Lophelia* coral were discovered growing on the wreck located at a depth of 1,820 ft.

There are now numerous industry-related structures at water depths below 1,000 ft in the Gulf. The use of sub sea completions is rapidly increasing. The number of sub sea completion installations has risen from just 4 1990 to a recent high of 51 in 2001 alone, and nearly three fourths of these occurred in deepwater (>1,000 ft). A total of 102 were installed in deepwater between 2000 and 2003. Examples of extraordinary solid platforms include the Cognac and Bullwinkle platforms in 1,023 and 1,353 ft of water respectively. Bullwinkle has now been in place for 17 years and Cognac for 26 years. A third structure, the Pompano platform at a water

depth of 1,430 ft in block VK 989 has already been documented to have *Lophelia* coral growth on parts of its structure and it was only nine years old at the time of those observations. In Green Canyon Block 184, an EA has already been completed for the removal of the Gulf's first tension leg platform at a water depth of 1,762 ft. The operator, ConocoPhillips requested that they be allowed to leave the massive template on the seabed. There is a good possibility that this structure is colonized by deepwater corals that are known to exist at the nearby chemosynthetic community Bush Hill in GC 185.

Although there is not yet a complete understanding of how artificial reefs function on the continental shelf, particularly in the photic zone above 100 m, it is generally accepted that artificial reefs can serve a positive function by the creation of new hard bottom habitat in areas where hard bottom is naturally lacking (most of the Gulf of Mexico). In the case of fish, artificial reefs can act both as attraction devices and as new habitat where new fish biomass is created and exported, meaning production. The fouling community growing on new hard bottom provided by artificial substrate is unquestionably new production for those organisms that require hard substrate. The trophic linkages between the flux of organic material to deepwater fouling communities and potentially related fish communities are not well understood.

Objectives: The purpose of this follow-up study is to make direct observations on deep Gulf oil and gas structures to evaluate their biological communities and determine to what degree they are serving as artificial reefs with some environmental value. This study is intended to further explore the basic question, "Do man-made artificial structures function as artificial reefs in deep water?"

Methods: Study methods will require the use of a deep remotely operated vehicle (ROV). Manned submersibles would likely not be a viable option as they would not attempt to approach any underwater structures such as a platform or sub-sea completions with unknown obstructions. Sampling methodologies would include underwater imagery, detailed image analysis, and limited specimen collection. The structures observed will be the same ones that will eventually be considered for decommissioning options. Complimentary collaborations with investigators from USGS/BRD will be likely during this project resulting in a cost sharing benefit and broader approaches to additional ecological disciplines.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): North, Mid, and South Atlantic and the Straits of Florida

Title: Energy-Related Infrastructure in the Atlantic Region

MMS Information Need(s) to be Addressed: The study will help MMS understand the existing onshore energy infrastructure in the Atlantic region and the extent to which it is capable of supporting new offshore energy projects. The study will also identify the onshore communities where the supporting infrastructure is located, which are the communities where most of the socioeconomic impacts from offshore projects are likely to take place. The information will be used for developing sections of Environmental Impact Statements.

Cost Range: (in thousands) \$200-\$225

Period of Performance: FY 2007-2008

Description:

Background: The Energy Policy Act of 2005 grants MMS new responsibilities over Federal offshore renewable energy and related-uses of the OCS. Under this new authority, MMS also becomes the lead Federal agency of permitting and regulatory oversight of the Cape Wind project, offshore Nantucket, Massachusetts, and any other projects already submitted to the U.S. Army Corps of Engineers. In light of this potential new use of the Atlantic OCS, as well as some renewed interest in traditional oil and gas development in the Atlantic region, MMS needs to gain a better understanding of the existing energy infrastructure in place in the region to support these projects.

Objectives: The backbone of offshore energy development is the supporting infrastructure in coastal areas of the region. An earlier study sponsored by MMS (*OCS-Related Infrastructure in the Gulf of Mexico Fact Book*, MMS 2004-027; hereafter referred to as “Infrastructure Fact Book”) surveyed a wide range of existing onshore infrastructure supporting offshore activities in the Gulf of Mexico, including platform fabrication yards; shipbuilding & shipyards; ports; support & transport facilities; waste management facilities; pipelines; pipecoating yards; natural gas processing plants; natural gas storage facilities; refineries; and petrochemical facilities. A standardized set of topics was covered for each facility type that included an introduction, a description of the infrastructure and a typical facility, industry characteristics, a survey of the important regulations governing facility operations, and a survey of industry trends and outlooks. The objective of this study is to develop a parallel infrastructure fact book for the Atlantic region. Additional infrastructure categories may need to be examined, including the power grid.

Methods: The methodology will consist of a literature review, data collection from public sources, discussions with key industry representatives, and analysis and synthesis of the collected data and information.

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ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Eastern, Central, and Western Gulf of Mexico, North, Mid, and South Atlantic, and the Straits of Florida

Title: Siting Issues and Resource Availability for Alternative Energy Project Scenarios in the Gulf of Mexico and Atlantic Planning Areas

MMS Information Need(s) to be Addressed: The possible social and economic effects of the OCS leasing program are among those of greatest concern to the public and to Federal, state, and local officials. As MMS widens its scope by becoming the lead authority for renewable energy projects, there will be many new and complex community stakeholder issues that will involve defining, researching, and recommending solutions or mitigation. The information will be used for developing sections of Environmental Impact Statements, particularly for analyzing and discussing the economic impacts of alternative energy projects. Information collected may also be used to expand the Agency's existing economic impact model to add the capability of analyzing alternative energy projects.

Cost Range: (in thousands) \$250-\$300

Period of Performance: FY 2008-2010

Description:

Background: The Energy Policy Act of 2005 grants MMS new responsibilities over Federal offshore renewable energy and related-uses of the OCS. Under this new authority, MMS becomes the lead Federal agency of permitting and regulatory oversight of the Cape Wind project, offshore Nantucket, Massachusetts, and any other projects already submitted to the U.S. Army Corps of Engineers. MMS has neither conducted any studies to predict where future alternative energy projects may occur, nor examined the potential socioeconomic effects of these projects on local communities. This study will help fill a critical information gap that will be needed in future MMS environmental assessments.

Objectives: The objective of this study is to predict the most likely locations for future alternative energy projects (wind, wave, solar, and other proven technologies) by examining the necessary technical, environmental, and market conditions (including options/availability to tie in to existing energy infrastructure). After examining what conditions are necessary to make a project technically and economically feasible, the study will identify locations that are most likely to support alternative energy projects. After these areas are identified, the study will describe the existing socioeconomic conditions in these communities, some of which may not have a long history of energy production. The information derived from this study will be critical in identifying the communities most likely to be impacted by alternative energy projects. It will also allow decision makers to examine the potential community impacts (e.g., employment, income, public services, infrastructure, tourism, and aesthetic resources) of renewable and alternative energy projects across the Gulf of Mexico and Atlantic Regions.

Methods: The methodology will consist of a literature review, data collection from public sources, discussions with key industry and community representatives, and analysis and synthesis of the collected data and information.

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ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Central and Western

Title: Investigation for Potential Spanish Shipwrecks in Ultra Deepwater

MMS Information Need(s) to be Addressed: To date, very little historical information of colonial shipping patterns has come to light for the GOM. This study, which focuses on the discovery of historical documents pertaining to the colonial period, will provide the agency a greater understanding of the potential for historic shipwrecks in the Ultra Deep Waters of the GOM. Furthermore, the knowledge gained through this study will offer best management practices for sites located on the OCS in Ultra Deep Water by supplying the MMS with an idea of what these early shipwrecks look like as they traveled through the water column and became embedded in the seafloor. Adaptive management strategies can then be used to provide protection for these sites and their associated debris fields as well as free up areas for exploratory drilling and the construction of infrastructure on the OCS.

Cost Range: (in thousands) \$400-\$600

Period of Performance: FY 2007-2008

Description:

Background: Historic shipwrecks have, to date, been discovered through oil industry sonar surveys in water depths of up to 6,500 feet. Many of these wrecks previously were not known to exist in these areas from the historic record. Taking these discoveries into account, MMS now requires archaeological survey in some deepwater areas, primarily on the approach to the Mississippi River, among those lease areas requiring archaeological investigation.

New information has come to light suggesting a higher potential for early (16th-18th century) shipwrecks in the Ultra-Deep Water (UDW) part of the GOM (particularly in the Sigsbee Escarpment, Keathley Canyon, and Walker Ridge areas) than previously was suspected. MMS studies to date have largely discounted the presence of Exploration or Colonial Period shipwrecks in significant numbers in the GOMR because of the paucity of reported shipwrecks from those periods in the secondary literature. What has not been explored thoroughly are losses associated with causes other than wrecking (such as fire, structural failure of the hull, or armed attack) that would have caused a ship to sink far from land. Since the likelihood of anyone surviving such a catastrophe at sea also diminishes considerably, the likelihood of its loss site being accurately reported is almost nil. Generally, such ships would be reported as simply "lost at sea." Colonial Period shipwrecks in the UDW almost exclusively would be associated with the Spanish treasure fleets leaving annually from Vera Cruz in Mexico bound for Havana, Cuba, and eventually for Spain. Hundreds of ships, laden with silver from the mines in central Mexico, made the passage to Cuba. Prevailing winds and currents in the Gulf dictated that fleets sailed north northwest from Vera Cruz to about 26° north latitude before turning east for Florida (Figure 2. Losses of ships on this route are poorly understood.

Vessels of this period found in the UDW of the GOM likely would be exceptionally well preserved with no disturbance from man or the mixing action of storms. Marine organisms have been found to attack and destroy wooden ships' hulls even in deep water so that sites are likely to appear deflated. There will likely be only a slight expression of the site above the seafloor. It also may be widely scattered, if the vessel spilled its contents over a wide area in its plunge to the bottom through thousands of feet of water. As a result, these sites, which potentially are among the most historically significant shipwrecks of any in the world, will be difficult to detect and to recognize.

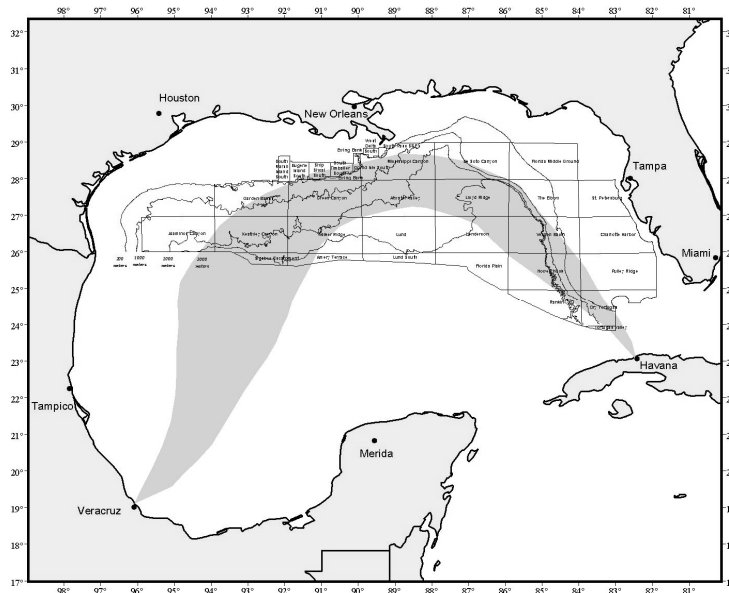


Figure 2. Route of the “New Spain Fleet” based upon contemporary charts and pilot books.

Objectives: Develop a strategy for identifying and recognizing such sites.

Methods: The study should focus on an analysis of Spanish records housed in the *Archivo General de Indias* to determine frequency of losses and potential for loss in the Central and Western Planning Areas. In addition, selected remote sensing targets located in the study area during routine industry surveys will be groundtruthed to determine their potential association with this historic period in order to characterize their physical extent, state of preservation, appearance in the remote sensing record, and potential eligibility to the National Register of Historic Places.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Western, Central, and Eastern

Title: Socioeconomic Effects of the Offshore Petroleum Industry on Urban Communities

MMS Information Need(s) to be Addressed: Socioeconomic impact assessment generally addresses rural communities and past MMS studies have reflected this focus. However, in the GOMR, the majority of the onshore socioeconomic effects of offshore oil have occurred in urban areas. This study will examine the effects on urban communities. The information will be incorporated in future environmental assessments.

Cost Range: (in thousands) \$250-300

Period of Performance: FY 2008-2010

Description:

Background: As detailed in the findings of the MMS sponsored 2004 workshop (MMS 2005-016) on socioeconomic issues for the GOMR OCS, one of the major topics was the lack of information on the socioeconomic effects of offshore oil and gas activities on urban communities. Economic and social effects of OCS activities primarily occur in urban areas. In addition, much of oil and gas related employment is also concentrated in large metropolitan areas. Despite these facts, previous MMS studies have not adequately examined how large cities and its residents are impacted by changes in the offshore petroleum industry. In general, prior MMS studies have assumed that most socioeconomic effects in large cities are diffuse due to large populations and therefore are not as significant as those in small, rural communities. This study will provide some insight on the best strategy to analyze and predict socioeconomic effects of the industry in large communities.

Objectives: The objectives of this study are to:

- describe and analyze the social and economic effects of offshore oil and gas related activities in large cities in the GOMR; and
- develop a methodology that is appropriate for analyzing these effects in large cities that can be applied to other metropolitan areas in future environmental assessments and studies.

Methods: The study area will consist of at least two major GOMR cities. Prior to August 29, 2005, New Orleans, LA and Houston, TX may have been the best cities to analyze in this study. Although the study may compare New Orleans and Houston, the 2005 hurricane season created new issues and potential problems in basing the study strictly on these two cities. Both New Orleans and Houston have experienced unprecedented demographic, social, and economic changes due to hurricanes Katrina and Rita. The same factors that make these cities important to address (i.e., both highly involved in OCS activity, different historical, cultural, and economic

ties to the offshore oil and gas industry, etc.) also make these cities difficult to study due to ongoing hurricane effects. The developed methodology will not only need to address complex and large urban communities, but also isolate the effects due to OCS activities from those due to the hurricanes and other ongoing changes in the environment.

This analysis will address but will not be limited to the following issues that are particularly relevant in examining urban effects:

- community identity;
- shifts in the tax base;
- civic groups;
- real estate markets;
- transportation and infrastructure;
- changes in residential and local business patterns; and
- schools and education.

The study can examine historical effects due to industry change, but it should primarily focus on current conditions and potential effects in the future. Although the study will be used in assessments to describe the consequences of the offshore petroleum industry on at least two cities, the standard analytical technique will be applied to other metropolitan areas in the region.

The methodology will consist of data collection from public and/or nonpublic sources, interviews with key industry and community representatives, and analysis and synthesis of the collected data and information. The project will, at minimum, compare and contrast offshore petroleum's effects in Houston and New Orleans, two centers of industry activities.

Revised Date: October 26, 2006

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2007-2009

Region: Gulf of Mexico

Planning Area(s): Gulfwide

Title: Meteorological and Wave Measurements for Improving Meteorological and Air Quality Modeling

MMS Information Need(s) to be Addressed: Wind and wave measurements are needed to improve meteorological and air quality models and to derive dispersion parameters for use in air quality model and assessment. These field measurements will improve the accuracy of meteorological and air quality models and benefit air quality assessments to be used in environmental impact statements. The data will be used to improve air quality modeling used to predict and assess 8 hour ozone, visibility, and haze in NEPA documents.

Cost Range: (in thousands) \$400-\$600

Period of Performance: FY 2008-2010

Description:

Background: Meteorological and wave measurements are needed to characterize the atmospheric boundary structure and air-sea interaction (flux parameterization) and to test theories (e.g., COARE algorithm, flux calculations) such that this information can be used to improve the application of meteorological and air quality models in the offshore environment. The MMS has conducted several meteorological studies in the GOM; however, these wind measurements need further updating for offshore meteorological and air quality assessments.

In previous MMS studies, the simultaneous measurements of wind and wave in the lower level of the atmospheric boundary layer offshore were not available. The information gathered from previous studies will help set up a more comprehensive field measurement system to collect more accurate wind and wave data. The proposed study will take advantage of existing boundary layer studies and provide updated data, science and information for improving the accuracy of meteorological and air quality modeling. Therefore, it is proposed to install a meteorological measurement system offshore to obtain information for atmospheric boundary layer study.

Objectives: The objectives of this study are to collect wind and turbulence characteristics, and wave data, to improve the COARE algorithm for shallow water, and to characterize the atmospheric boundary layer structure for air quality modeling.

Methods: Plan and install a new wind measurement system using wind profilers, sodar, buoys, and meteorological wind measurement sensors mounted on an offshore platform or a 100 m meteorological tower.

Revised Date: October 26, 2006

SECTION 3 TOPICAL AREAS FOR FY 2008 AND BEYOND

The GOMR is expecting a continuation of offshore oil and gas activities at its current pace. Issues that may result in future studies include industry's continued move into deepwater; air quality; gas hydrates; decommissioning; and understanding the chronic sublethal impacts associated with offshore development and production, that is, fates and effects.

3.1 Deepwater

Deepwater habitats are the least understood marine environments of the Gulf of Mexico. Several major deepwater studies were initiated in the recent past to broaden our limited knowledge base of deepwater benthic ecology. Several are coming to a conclusion in 2006. Final reports from these studies will be published in 2006. The results from these studies will lead to new areas for further investigation.

Several major studies are currently collecting or have recently completed measurements of currents in deepwater. Once completed, this dataset will span from DeSoto Canyon in the east to the Alaminos Canyon in the west and includes observations south of the Exclusive Economic Zone. The next step will include modeling of the data and incorporation of the information into oil spill assessments. We will hold a workshop to discuss the results and future endeavors including additional measurements and modeling.

3.2 Fates and Effects Studies

The OCS supports large and valuable commercial and recreational fisheries, and concern has been expressed that the oil and gas industry may contaminate these resources or the supporting ecosystem. Understanding the chronic, sublethal impacts that may be associated with offshore oil and gas activities is a concern to many. Questions continually arise as industry moves into deeper water and new technology is applied and as scientists discover increasingly subtle adverse effects resulting from pollution. The studies program is continuously addressing the information needs in this constantly evolving area and will develop new studies as the need arises

3.3 Air Quality

Currently, MMS is collecting the third Gulfwide emissions inventory. This information is used to evaluate the contributions to ozone and other pollutants to onshore communities. At some point, there may be a need to use these data to model 8-hour ozone levels, in accordance with recent regulations promulgated by the Environmental Protection Agency.

3.4 Gas Hydrates

Exploration into the location and distribution of gas hydrates along the continental slope of the Gulf of Mexico is presently underway. Currently MMS is making the first assessment of hydrates as a potential economic resource in all offshore locations. While the Gulf of Mexico is not considered the most likely viable source of gas from hydrates, other locations, such as the Blake Plateau on the Atlantic OCS, are being considered.

3.5 Decommissioning

Over the next decade, it is expected that a large number of the over 4000 structures in the Gulf of Mexico will be removed. These structures have supplied a hard surface for organisms to flourish, creating an artificial ecosystem and affecting the distribution of species. The decision to retain or remove these structures will need to be made based on the implications to the ecosystem. An initial literature search and data synthesis is currently being procured. Results of this study could identify additional research gaps.

3.6 Alternative Energy

The Energy Policy Act of 2005 grants MMS new responsibilities over Federal offshore renewable energy and related-uses of the OCS. Under this new authority, MMS also becomes the lead Federal agency of permitting and regulatory oversight of the Cape Wind project, offshore Nantucket, Massachusetts, and any other projects already submitted to the U.S. Army Corps of Engineers. In light of this new responsibility, MMS needs to begin collecting the data and information necessary to analyze the economic impacts of these new types of projects. Several studies are being developed and will examine future alternative energy planning scenarios and alternative energy infrastructure.

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