BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Examining and Testing Potential Prehistoric Archaeological Features on the Gulf of Mexico, Offshore Continental Shelf (GM-92-42-136)

Planning Areas: Central and Western

Total Cost: $367,095 **Period of Performance:** FY 2007-2012

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEM Contact: Melanie J. Damour

Description:

Background: Previous remote sensing work on the Outer Continental Shelf (OCS) has identified two high probability areas (South Marsh Island, LA, and Galveston, TX) with potential prehistoric sites in the Western and Central planning areas located within the upper 5 feet of sediment. A third area in High Island Area, Western planning area, contains a deeper feature has been tentatively identified as a midden located approximately 12 feet below the seafloor. The proposed project directly relates to the core mission of the Bureau of Ocean Energy Management (BOEM) by addressing potential socioeconomic impacts to these cultural resources on the offshore continental shelf by evaluating the current survey guidelines and avoidance criteria for prehistoric features that may be impacted by oil and gas industry development. Because only limited testing has ever been performed, this study will attempt to determine if landforms and sites are being identified correctly from the geophysical remote sensing data acquired under guidelines published in NTL 2005-G07, and if these buried landforms/sites do indeed reflect, or actually are preserved prehistoric sites.

Objectives: The objectives of this study are to: 1) determine the accuracy of terrestrial analogues and the time, space, mechanism model for identifying high probability areas for prehistoric site occurrence and preservation in the wider Gulf of Mexico (GOM) OCS planning districts; 2) determine if the core analysis data identified in previous studies represent a universal set of characteristics indicative of prehistoric archaeological deposits, or is either areally restricted to the Sabine River Valley or temporally restricted to the Paleoindian period; 3) identify additional core analysis that suggest, or are indicator factors for archaeological deposits; 4) assess the optimal line spacing for acquisition of sub-bottom profiler data to detect geologic and potential archaeological features; and 5) identify possible discrete archaeological features that are located within depths that can be tested through excavation.

Methods: Most archaeological investigations conducted to date on submerged prehistoric sites around the world have focused on sites that are still exposed at the seafloor and accessible to divers and seafloor scanning instruments. The methods and techniques used

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Dynamics of the Loop Current in U.S. Waters (GM-08-01)

Planning Area: Eastern

Total Cost: $5,497,000.00 **Period of Performance:** FY 2009-2013

Conducting Organization: Science Applications International Corporation

BOEMRE Contact: Dr. Alexis Lugo-Fernández

Description:

Background: The most influential driving force in the Gulf of Mexico 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 $km \cdot day^{-1}$. This strong jet with surface velocities on the order of 150 $cm \cdot s^{-1}$ dominates the mesoscale variability of the Gulf, especially in deepwaters where it is believe to influence the current filed 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 knowledge of this current is through indirect methods or hydrographic surveys, satellite studies, numerical modeling, and a few moorings (about 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 (Exploratory study draft final report) and ray tracing techniques suggest that Rossby waves originated near the Loop Current in the eastern Gulf however, we lack unequivocal data on this and even the mechanism(s) to generate these Rossby waves. Recommendations in the Exploratory study draft report suggest the analyses of the detachment processes, the vertical coupling, and effects of LC frontal eddies in eddy shedding to better understand the role of the LC on the overall Gulf oceanography.

Objectives: The purpose of this study is to make observation inside the LC for a period of three years and to analyze the data of ocean currents to learn about the dynamics of this current. The observed data will be used to understand and improve predictions of the

shedding mechanism and energy leak from surface to bottom.

Methods: Standard oceanographic methods (moorings, PIES, and hydrographic surveys) will be employed to collect ocean current data and to analyzed the resulting data to extract as much information and knowledge as possible. Satellite data will be needed to provide the synoptic view plus data on other aspects of the LC that are available only through this technology. The accompanying figure presents the Government's conceptual design of the mooring array, consisting of nine locations in the study area. The performance period will be divided into three years of field work and data collection and two years for data analyses and report completion.

Products: A dataset of ocean currents measured, technical reports, technical presentations, and scientific publications in peer reviewed journals.

Importance to BOEMRE: This study will help Bureau of Ocean Energy Management, Regulation and Enforcement to better assess the LC dynamics and its importance to the Gulf's oceanography and circulation, and its role in the generation of Rossby waves and eddy shedding mechanism. The study and products should help improve numerical models in the Gulf by incorporating the insights gained in this study that in turn would help make better predictions.

Current Status: Rotation cruise was completed in Summer 2010 with a ca. 90% data return. The retrieval cruise will occur on Winter 2011.

Final Report Due:	September 2013
Publications:	None
Affiliated WWW Sites:	None
Revised date:	February 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Simulation Modeling of Ocean Circulation and Oil Spills in the Gulf of Mexico (GM-11-02)

Planning Area: Gulfwide

Total Cost: $989,361 **Period of Performance:** FY 2011-2015

Conducting Organization: Applied Science Associates, Inc.

BOEMRE Contact: Dr. Rebecca Green

Description:

Background: The Department of Interior (DOI), specifically the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), invests in ocean research through the Environmental Studies Program to provide science in support of management decisions. An objective of the bureau's Oil Spill Modeling Program is to conduct research that will improve its estimates of oil-spill transport, fate, and impacts to the environment. To this end, numerous studies have previously been funded in the Gulf of Mexico to improve the understanding of the physical oceanography, oil-spill fates, and ecological impact processes in the region. Recent deepwater events in the Gulf of Mexico created a need for modeling efforts to simulate plume behavior in both surface and subsurface waters and to perform a variety of scenario runs to meet BOEMRE's various research and management objectives. It is essential for BOEMRE to simulate deep oil spills and their environmental impacts, so that it can fully understand what has happened in the past, learn from those events, and have better risk assessment and oil spill contingency plans in the future.

Objectives: The objective of this project is to develop and apply an integrated oil spill model that incorporates many of the processes which are unique to deep oil spills, with the ultimate goal of accurately simulating oil plume behavior at different depths in the water column. This modeling will incorporate the various processes responsible for oil transport and fate. In addition, model results will provide a variety of scenario runs exploring a range of outcomes from deep oil spills. An important aspect of the intended work will be comparison between model results and oil observations.

Methods: The objectives of this study will be met through development and application of an integrated oil spill model which simulates oil plume behavior as accurately as possible by incorporating the various environmental and chemical elements unique to deep spills. The study will develop an oil spill model, using an existing 3D ocean circulation model integrated into a 3D particles and concentrations model, which simulates oil plume transport and fate in the surface, sub-surface water column, and deposited in sediments and along shorelines. This modeling will include development of

a new predictive blowout model. Model parameterization will incorporate oil attenuation and weathering processes, such as advection and dispersion, evaporation, settling, and degradation in water and sediments. An important component of the study will be validation of the model with actual observations of plume transport and oil concentrations, including data from airplane overflights, satellite imagery, and water and sediment chemistry measurements. The integrated model will be applied to a series of scenario runs, which will include, for example, changes in the total volume of oil released; the amount of surface and subsea dispersant applied, and spill location.

Products: Synthesis Reports, Datasets and Model, Peer Reviewed Publications, and Conference Presentations

Importance to BOEMRE: This study will develop, validate, and implement an integrated oil spill model which accurately simulates oil plume movement and fates in surface and subsurface waters of the Gulf of Mexico. Scenario runs will be conducted to inform BOEMRE risk assessment and oil spill contingency planning, as well as NEPA documents, on the range of possible spill outcomes.

Current Status: This study was recently awarded.

Final Report Due: August 2015

Publications: none

Affiliated WWW Sites: none

Revised date: September 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Gulfwide

Title: Lagrangian Study of the Deep Circulation in the Gulf of Mexico (GM-10-03)

Total Cost: $4,696,503 **Period of Performance:** FY 2010-2015

Conducting Organization: Science Applications International Corp

BOEMRE Contact: Dr. Alexis Lugo-Fernández

Description:

Background: During the recently completed MMS study of deepwater current near the Mississippi Delta, deep drifters were released and tracked acoustically for nearly six months, about half of the time intended due to manufacturing problems of the sound sources. This short database produced tantalizing observations. Some include, deep circulation of the deep northern Gulf consists of a western and eastern cell divided about 90°W; other tracks hardly showed any net movement; while others locked into an isobath and move along it and some even reach the Campeche Bay. However, the short observing period and geographically limited releases do not allowed more broad and robust conclusions. In order to secure robust results, the need for a basin-wide release of submerged drifters coupled with profiling drifters are needed over a longer time frame and releases at several places within the Gulf basin seem warranted. Thus, the propose study was conceived to fill this void.

Objectives: The overarching goal of this study is to increase our knowledge of the deep circulation of the Gulf of Mexico through analysis of observations of deepwater tracked drifters. Specific objectives are:

- To deploy submerge and profiling drifters over three years inside the Gulf Mexico;
- To analyzed these data to produce maps of currents in the deep waters of the Gulf;
- To estimate Lagrangian statistics of these current fields such as length and temporal scales;
- To make estimates of particle horizontal dispersion and explore the feasibility of estimating vertical dispersion through deployment methodologies in the deep waters to help understand dispersion of pollutants and biological material; and
- To provide information for BOEMRE to fulfill its regulatory mission and comply with NEPA requirements.

Methods: This study will employed submerged drifters that can be tracked using sound from several active sources placed strategically inside the Gulf of Mexico. The

submerged drifters will remain underwater for a period of 12 months; afterward they surface and transmit via satellite their data. Immediately the Gulf will be re-seeded with more drifters and the entire cycle will be repeated three consecutive years. The remaining time will be devoted to QA/QC, analyses, and report preparation. We should explore releasing profiling drifters along to detect the T-S distribution during the study. Because the timing and duration of this study, it is envisioned that some overlapping will occur with the Loop Current Dynamics Study in the eastern Gulf of Mexico.

Products: Synthesis Reports, Datasets, and Peer Reviewed Publications

Importance to BOEMRE: The results of the study will provide map(s) of deep currents that will help with the assessment of accidental pollutant releases, and shed light on dispersal of larvae. These improved maps of currents will be used by BOEMRE and Industry to prepare for and avoid high currents, make better biological assessments for our regulatory documents, and increase our understanding of the deep circulation and its variability. Finally, these current maps could be used by archeologist to help during investigations of shipwrecks in the deep Gulf.

Current Status: After a successful completing the post-award meeting, preparations for the first deployment continue as planned during Summer 2011.

Final Report Due:	September 2015
Publications:	none
Affiliated WWW Sites:	none
Revised date:	February 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Western and Central

Title: Year 2011 Gulfwide Emissions Inventory Study (GM-10-02)

Total Cost: $325,000

Period of Performance: FY 2009-2013

Conducting Organization: Eastern Research Group, Inc.

BOEMRE Contact: Holli Ensz

Description:

Background: On March 12, 2008, the Environmental Protection Agency (EPA) significantly strengthened its National Ambient Air Quality Standards (NAAQS) for ground-level ozone. EPA revised the 8-hour "primary" ozone standard to a level of 75 parts per billion (ppb) and strengthened the "secondary" standard to the same level of 75 ppb, making it identical to the revised primary standard. States must make recommendations to EPA no later than March 2009 for areas to be designated attainment, nonattainment, and unclassifiable. EPA will then issue final designations no later than March 2010, unless there is insufficient information to make these designation decisions. In that case, EPA will issue designations no later than March 2011. States must submit State Implementation Plans (SIPs) detailing how they will reduce pollution to meet the standards by a date that EPA will establish in a separate rule. That date will be no later than three years after EPA's final designations. If EPA issues designations in 2010, then these plans would be due no later than 2013.

Previously, EPA also enacted stronger particulate matter ($PM_{2.5}$) standards and regional haze regulations to improve visibility. Due to the more stringent NAAQS, it is likely that many of the regions adjacent to the Gulf of Mexico will face even greater challenges in attaining air quality standards in their respective states in 2011. The changes to all these standards/regulations may require state agencies to perform air quality photochemical modeling for ozone and regional haze for use in their SIPs. In order to conduct this modeling, emission inventories must be generated as inputs to the models. The 2011 gulfwide emissions inventory will be available to assist states in conducting modeling for additional SIP demonstrations to meet the new requirements. The collection and compilation of an air emissions inventory is one of the tasks that BOEMRE conducts to assure coordination of air pollution control regulations between Outer Continental Shelf (OCS) offshore sources and state's sources onshore (as per Section 328(b) of the 1990 CAAA).

The 1990 Clean Air Act Amendments (CAAA) specifies that states are to prepare emission

inventories every three years, starting in 1996. The proposed 2011 gulfwide emissions inventory will correspond with the next EPA onshore periodic emissions inventory. BOEMRE has completed a 2000 and 2005 gulf-wide emissions inventories, and is currently developing a 2008 gulf-wide emissions inventory. By conducting a 2011 gulfwide emissions inventory, BOEMRE is working concurrently with EPA's routine, 3 year reporting cycle.

Recently, Congress directed EPA to publish a mandatory greenhouse gas reporting rule, using the Agency's existing authority under the CAA. The rule, if adopted, will require mandatory reporting of greenhouse gases "above appropriate thresholds in all sectors of the economy." EPA is responsible for determining those thresholds, as well as the frequency of reporting. A final rule is due by June 2009. The proposed 2011 gulfwide emissions inventory includes greenhouse gases.

Lastly, the inventory will be used to enhance the BOEMRE NEPA process by providing an accurate inventory to compute emission trends and to perform necessary air quality impact assessments.

Objectives: The purpose of this study is to develop a year 2011 air emissions inventory of OCS sources (platform and non-platform), including estimates of carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM_{10} and $PM_{2.5}$), hydrocarbons (VOC), carbon dioxide (CO_2), methane (CH_4), and nitrous oxides (N_20) to support SIPs and to enhance the BOEMRE NEPA process.

Methods: A contractor will collect and compile emissions activity data from BOEMRE regulated OCS facilities and vessels. Facilities include all installations (e.g., production platforms) or devices having the potential to emit any air pollutant, as above. The platform activity data will be collected using the BOEMRE emissions activity software, Gulfwide Offshore Activity Data System (GOADS). In addition, emissions from vessels used to support facilities (non-platform sources) will be collected using surveys. The contractor will quality control and assure all data collected, including making sure the vessels data collected in BOEMRE federal waters is consistent with the vessels data in states waters. The Contractor will calculate a total emissions inventory, by pollutant, using the existing Database Management System, which multiplies the activity data contained in GOADS times the appropriate emissions factors.

Products: The contractor shall provide the BOEMRE with electronic files of the quality assured survey and activity data collected from OCS facilities in the GOADS software. In addition, the contractor shall provide the BOEMRE with a quality assured emissions inventory of platform and non-platform sources in an electronic format compatible with BOEMRE's database management software and EPA's most recent format. This data must be able compatible with the EPA's Emissions Inventory System (EIS), which stores all current and historical onshore emissions inventory data. All results will be documented according to BOEMRE report standards.

Importance to BOEMRE: First, the collection and compilation of an air emissions inventory is one of the tasks that BOEMRE conducts to assure coordination of air pollution control regulations between OCS offshore sources and state's sources onshore. Secondly, this

emissions inventory will likely useful for compliance with EPA's Greenhouse Gas Reporting Rule. Finally, BOEMRE will also use the 2011 emissions inventory to support the NEPA process when preparing Environmental Impact Statements and Assessments, and for emissions trends and impacts analysis.

Current Status: NTL No. 2010-G06 has been posted online to notify the operators that they must collect platform activity data for calendar year 2011 by using the GOADS-2011 software. The NTL also detailed a GOADS-2011 workshop on October 13, 2011, where operators had opportunities to discuss the software and ask questions about the software to ERG. Also, a GOADS-2011 webpage has been added to the BOEMRE GOMR website, which has all necessary information on the GOADS-2011 effort, including software, User's Guide, and Frequently Asked Questions about the software. Currently, operators should be gathering their activity data offshore using the GOADS software.

Final Report Due: July 2013

Publications: None

Affiliated WWW Sites: http://www.gomr.boemre.gov/homepg/regulate/environ/airquality/goads.html

Revised date: February 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Gulfwide

Title: Meteorological and Wave Measurements for Improving Meteorological and Air Quality Modeling (GM-08-04)

Total Cost: $637,457 **Period of Performance:** FY 2009-2011

Conducting Organization: Sonoma Technology, Inc.

BOEMRE Contact: Dr. Chester Huang

Description:

Background: Meteorological and wave measurements will be used 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 and the coastal area. The BOEMRE has conducted several meteorological studies in the GOM; however, these wind measurements need further updating for offshore meteorological and air quality assessments. This study is also needed in the other studies such as wind energy, climate change, and real time weather forcasting. This study is a unique program with historical significant.

In previous BOEMRE studies, the simultaneous measurements of wind and wave in the lower level of the atmospheric boundary layer offshore were not available and there were data gaps between 10 m and 100 m. 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 characterize the atmospheric boundary layer structure and air-sea interaction for improving meteorological and air quality modeling over coastal transition zone, shallow water and deep water areas. Furthermore, this study is to focus on the data gaps between 10 m to 100m above the sea surface and the transition zone between land and ocean.

Methods: Conduct field observations and data collection. Plan and install a new wind measurement system using wind profilers*, sodar, buoys*, LICOR humidity sensor, float sensor (for measuring near surface temperature), and meteorological wind measurement sensors mounted on an offshore platform or a 100 m meteorological tower*.
*not implementd; unfunded

Products: Annual and final reports and peer reviewed articles.

Importance to BOEMRE: The collected data will be used to improve meteorological and air quality modeling used to predict and assess 8 hour ozone, visibility, and haze in NEPA document.

Current Status: Kick-off meeting held in January 2009. A new wind-wave measurement system has been deployed to an oil platform and data have been collected.

Final Report Due:	December 2011
Publications:	2010 AGU Fall Meeting
Affiliated WWW Sites:	None
Revised date:	February 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Current-Topography Interaction and Its Influence on Water Quality and Contaminant Transport Over Shelf-Edge Banks (GM-10-05)

Planning Area: Western

Total Cost: $717,500.00 **Period of Performance:** FY 2010-2013

Conducting Organization: Naval Research Laboratory

BOEMRE Contact: Dr. Alexis Lugo-Fernández

Description:
Background: The northwestern shelf of the Gulf of Mexico has many topographic banks some of which have hermatypic coral communities, the Flower Garden Banks (FGB) being the archetypical example. These banks are large enough to affect the impinging water flow. These topographic interactions can substantially modify advection and transport of water and matter over reef communities. Unlike nearshore reefs of shallower waters which are wave dominated and strongly influenced by runoff, the ecology of shelf-edge bank communities seems to be dominated by current-topography interactions. The resulting flows provide an energy subsidy for nutrient uptake, waste removal, dispersal of larvae, and regulates the physical environment that allows these communities to grow.

Effects from storms have been evident on GOM shelf-edge banks in recent years. The autumn of 2005 saw the worst bleaching event on record for corals at the FGB which coincided with two significant storms (Hurricanes Katrina and Rita) that crossed the banks. It was followed by disease outbreaks affecting the coral at the FGB. Measurement of water quality parameters before and after these events was patchy and unreliable.

Natural variations in water quality can produce effects similar to anthropogenic effects, thus confounding a determination of cause. Runoff from major storms carrying excess nutrients and contaminants can potentially reach these offshore banks. Bottom sediments disturbed by storms and currents can carry contaminants onto low relief features but debate remains whether they reach the upper portions of banks. Knowledge of natural changes in water quality is necessary to enable the BOEMRE to identify potential effects resulting from oil and gas activities. An initial assessment of these interactions was conducted by a single study in the early 1980s using limited current meters and

hydrographic observations. Today, we have better technology and greater knowledge that allows deeper insight into the ecological role of the current-topography interaction affecting the ecology of these reefs.

The BOEMRE and the NOAA Flower Garden Banks National Marine Sanctuary have a long history of cooperating in monitoring shelf-edge bank communities. This cooperation will continue throughout this proposed study which will include providing ship facilities and time. The Sanctuary has a dedicated research vessel to provide an oceanographic platform for studies of this magnitude.

Objectives: The purpose of this study is to elucidate the role of water circulation and its interaction with topography in the maintenance of reef communities. The objectives are:

- To produce a 3-dimension view of the flow and fields around a selected bank and extrapolate that view to describe other banks in the region;

- To increase our understanding of the effects of topography and water stratification on circulation around the banks and the resulting energy subsidy to reef communities;

- To gather information on water quality to characterize environmental conditions (e.g., light, nutrients, temperature, flow, etc.) affecting the biota and larvae dispersal at the bank; and

- To assess pathways for potential oil and gas impacts on bank communities from adjacent shunting and surface discharge activities.

Methods: The study will conduct current and hydrographic measurements over two years at a selected bank using ADCPs and CTDs placed around the bank and supplemented with satellite-tracked drifter deployments upstream at the bank. Water quality parameters to be measured will include turbidity, pH, dissolved oxygen, photosynthetically active radiation (PAR, chlorophyll a, and others. Measurements during standard hydrographic cruises will include nutrients and selected pollutants. Sediment traps may be used to sample for immigrating contaminants. Tracer studies with rhodomine will also be conducted to reveal details of the flow-topography interaction.

The Flower Garden Banks are the largest banks with the shallowest crest and they support the most sensitive reef community in the northern GOM. A location at the Flower Garden Banks will be the selected site for the study.

Upon completion of the field work, analysis and data interpretation leading to a final report and perr-reviewed publications will follow. Additionally, it is expected that the database produced can assist with validation and calibration of numerical model of the shelf circulation.

Products: Synthesis Reports, Datasets, and Peer Reviewed Publications

Importance to BOEMRE: This study will shed light on circulation and environmental

conditions affecting reef organisms on sensitive habitats of the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) and support management decisions regarding oil and gas activities near mid-shelf or shelf-edge banks. This study will evaluate the degree of entrainment of near bottom waters and sediments (with potential detrimental factors) onto the mixed layer where sensitive biological features are located. Results of this study will confirm the basic assumptions for shunting, shunting zones and No Activity Zones in use for the past 30+ years. It will also determine natural water quality conditions over time and throughout the water column for the first time at a selected bank. Questions about potential transport and origins of contaminants to reef communities can be answered.

Current Status: The deployment of four ADCPs with thermistor chains around the eastern FGB was completed early 2011. Trying to secure funds for summer cruises seems highly unlikely due to the budget situation. This will severely impact the estimation of turbulence and mixing around the bank.

Final Report Due: February 2013

Publications: None

Affiliated WWW Sites: None

Revised date: August 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Current Measurements in the Yucatan-Campeche Area in Support of Loop Current Dynamics Study (GM-09-07)

Planning Area: Eastern Gulf of Mexico

Total Cost: $1,100,00.00 **Period of Performance:** FY 2009-2013

Conducting Organization: CICESE, Mexico

BOEMBRE Contact: Dr. Alexis Lugo-Fernández

Description:

Background: The most influential driving force in the Gulf of Mexico is the Loop Current (LC). The LC 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 LC sheds large warm or anticyclonic eddies (diameters of 200-400 km) that propagate to the western Gulf at speeds of 4 to 8 $km \cdot day^{-1}$. This strong jet, with surface velocities on the order of 150 $cm \cdot s^{-1}$ dominates the mesoscale variability of the Gulf, especially in deep waters where it is believe to influence the current filed 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 (about 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 it 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 (Exploratory draft final report) and ray tracing techniques suggest that Rossby waves originated near the LC in the eastern Gulf, but we lack unequivocal data on this and even the mechanism(s) to generate these Rossby waves. Recommendations in the exploratory study draft report suggest the analyses of the detachment processes, the vertical coupling, and effects of LC frontal eddies in eddy shedding to better understand the role of the LC on the overall Gulf oceanography.

Objectives: The purpose of this proposed study is to leverage ongoing measurements by Mexican scientists of the Yucatan-Loop Current in Mexican waters for a period of three years and to analyze the data of ocean currents to learn about the dynamics of this

current. This was a suggestion from our past workshop in US-Mexico Deepwater Oceanography in New Orleans. The observed data will be used to:

- Complement our LC dynamics study in US waters and improve the accuracy of our analyses and advance the knowledge;
- Extend the database of transport in the Yucatan Channel and provide realistic boundary condition for LC dynamics; and
- Leverage the ongoing program of current measurements in Mexican waters sponsored by Government agencies in Mexico. In the absence of such leverage data availability for our study could be minimal to none.

Methods: Standard oceanographic methods (moorings, PIES, and hydrographic surveys) will be employed to collect ocean current data and to analyzed 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 LC available only through this technology. The accompanying figure presents the government's conceptual design of the mooring array, consisting of nine locations in the study area. 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 BOEMRE is taking advantage of ongoing measurement campaigns by Mexican oceanographers in the Yucatan-Campeche area to improve the results of our $5 million investment in US water.

Products: Database, reports, and scientific publications.

Importance to BOEMRE: The data and results of the study will supplement our LC dynamics study by providing the upstream conditions in the LC. This enhanced database should help improve forecasting of eddy shedding and intrusions of the LC in the Gulf of Mexico. Improved forecasting capability will be employed by BOEMRE and industry to prepare for and avoid high currents during exploration and production activities, that such reduced among others things downtime, losses or accidental releases, and material fatigue all which are of concern to BOEMRE.

Current Status: The first rotation cruise was completed in Summer 2011 and the array redeployed. The retrieval cruise is scheduled for Sumer 2011. It seems highly unlikely that BOEMRE will acquire the entire data between Yucatan and Cuba.

Final Report Due:	October 2012
Publications:	None
Affiliated WWW Sites:	None
Revised date:	February 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Western, Central and Eastern

Title: Digitization and Reanalysis of Northern Gulf of Mexico Continental Slope Study Seafloor Photographs (GM-92-42-140)

Total Cost: $117,281 **Period of Performance:** FY 2008-2011

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEMRE Contact: Kate Winters

Description:

Background: The largest and most intensive benthic photographic survey taken in the deep Gulf of Mexico resulted from a previous MMS-funded study, the Northern Gulf of Mexico Continental Slope Study (NGMCS) by LGL Ecological Research Associates between 1983 and 1985 (final year's report MMS 88-0053). Since this extensive survey was performed, there have been advances in image processing, digital imaging, data storage, and spatial statistics that have greatly enhanced the ability to carry out intensive benthic survey analysis. This project will digitize and reanalyze the approximately 45,000 NGMCS images.

Imaging of the Gulf of Mexico bottom has continued since the NGMCS study, but never with the same intensity or intent to survey large areas. A more recent MMS study, the Northern Gulf of Mexico Continental Slope Habitat and Benthic Ecology Study (final report in revision) used a Benthos digital camera at 45 sites resulting in 1,421 images.

Objectives: The objectives of this project are to:

- Digitize and examine all images rather than the subsets previously used.
- Estimate faunal abundance within each transect (station) from counts and extent of bottom photographed.
- Estimate the degree of patchiness along a 1.7 +/- 1.0 km stretch of bottom with particular emphasis on changes along and across the slope for each camera tow treated as a transect.
- Test two hypotheses: a) the composition and abundance of megafauna and traces are homogenous across all transects, and b) within transects, megafauna and traces are randomly distributed.

Methods: The image data set consists of a total of approximately 45,000 35 mm film transparencies (slides) taken close to the bottom at a total of 60 stations on the continental slope between depths of 300 and 3,000 m. The original rolls of film consisted of 800 images on 100 ft long rolls. All 60 rolls were cut into strips for another project that utilized the images, but they were not utilized in a comprehensive way (The Deep Sea

Gulf of Mexico: An Overview and Guide MMS 2001-065.)

The methods will be straightforward. An initial screening and assessment of all images will be made on a light table assessing the numbers of usable images from each transect. Based on this assessment, a digitization plan will be developed and initiated. Images will be digitized at 8- megapixel resolution using a Nikon Coolscan 4000 scanner. Files will be saved using uncompressed Tagged Image File Format (TIFF) which allows the incorporation of analysis results and notes as a tagged field. All images will be digitized prior to initiation of examination and categorization. Images will be stored on DVD-type optical disks. Summary statistics for each image will be calculated based on color and texture. These serve both as an indicator of altitude above bottom and the nature of the bottom.

Statistical analysis will utilize statistical packages that incorporate distances and variations between multiple-points. Aggregation will be examined through segmental pooling of image sequences and testing for departures from randomness at increasing scale.

Products: Final report and digital image archive.

Importance to BOEMRE: The BOEMRE has already funded the most extensive deepwater bottom image survey on record. The further utilization of this pre-existing image data set will increase understanding of the distribution of megafauna on the continental slope of the Gulf of Mexico. Most regulation is based on the distribution of observable megafauna along with consideration of habitat type. Results of this project are expected to add to the ability to design the best methods and set standards for the future use of image gathering and data analysis. Offshore oil and gas activity continues to increase in all deepwater areas sampled by this study.

Current Status: No update has been provided since the previous status check. The transfer of all deep sea images from the LGL slope study has been made. All of the approximately 45,000 35 mm image frames are now in binders. The transfer was made face-to-face to avoid any loss or damage by mail carriers. The analysis stage has commenced. Discussion of manuscripts and final report preparation can begin.

Final Report Due:	June 2011
Publications:	None
Affiliated WWW Sites:	Coastal Marine Institute, Louisiana State University
Revised date:	February 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Central

Title: Biomass and Mass Balance Isotope Content of Seep Populations on the Upper Slope of Gulf of Mexico Determined from Archived Samples (GM-09-01-08)

Total Cost: $85,550 **Period of Performance:** FY 2010-2012

Conducting Organization: Louisiana State University Coastal Marine Institute

BOEMRE Contact: Dr. Maureen. M. Mulino

Description:

Background: In spite of considerable past and ongoing at-sea investigation many questions about Gulf of Mexico seep systems remain. Some are of a more basic nature, while others have clear management relevance. It is a central proposition of the work proposed herein that knowledge of temporal trends in seep communities is critical to BOEMRE's environmental management. It is now quite evident that not all seep communities change through time and are not all at the same stage of development. Some contain a diversity of actively growing individuals and are attracting recruits while others are near termination. Without a better knowledge of the course of seep initiation, errors might be made as to the cause of any changes observed in the proximity of oil and gas development. A natural decline might be misidentified as an impact.

Objectives: Specific project objectives for this proposal are to test

- whether or not there are significant differences in the condition index of archived deep water (seep population) mussels and nerite snails between samples collected from the inner and outer portions of mussel aggregates; and
- whether or not there are significant differences in trophic positions indicated by stable isotopes of archived deep water (seep population) mussels and nerite snails collected from the inner and outer portion of mussel aggregates.

Methods: It is proposed to carry out specimen by specimen analysis of 250 *Bathymodiolus childressi* and 250 *Bathynerita naticoidea* from paired samples in the specimen archive. Analysis will test for difference between position in a patch, patch of origin, and site of origin using CI (condition index based on ash free dry weigh biomass and shell volume) isotopic content. Ash free dry weight determinations will be based on techniques applied to site-specific samples collected 1989-1992 for the purpose of data uniformity. Stable isotope analyses will also examine ^{13}C, ^{14}N, and ^{34}S in a manner similar to previous analysis.

Products: Final Report, Presentation at the 26th Annual Gulf of Mexico Information Transfer Meeting, Publication in a Referred Journal

Importance to BOEMRE: The ability to identify the natural cycles of deep water seep communities and to distinguish the senescent communities from those physically damaged by anchor ropes, chains, pipelines and other oil related activities is important to BOEMRE in their management of seep communities. This study is a start seeking evidence of temporal changes in seep communities.

Current Status: Ongoing. On schedule as of now.

Final Report Due:	May 2012
Publications:	N/A
Affiliated WWW Sites:	N/A
Revised date:	June 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: South Atlantic

Title: South Atlantic Information Resources: Data Search and Literature Synthesis (GM-09-x21)

Total Cost: $678,702.69 **Period of Performance:** FY 2009-2012

Conducting Organization: Research Planning, Inc.

BOEMRE Contact: Dr. Donald (Tre) Glenn

Description:

Background: The southern United States (US) Atlantic seaboard between Palm Bay, Florida and North Myrtle Beach, South Carolina has not been developed for potential renewable energy reserves. 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, bats, birds, fishes, and marine mammals, many of which are considered endangered or threatened.

The last synthesis of physical oceanographic information for the US Atlantic OCS was conducted for BOEMRE (formerly MMS) in 1981. Offshore of the south Atlantic is dominated by the mighty northward Gulf Stream until it hits the Charleston Bump and turns to northeast direction. The meandering and shoreward penetration of the Gulf Stream generates a complex flow patterns around the shelf break region. Other than hurricane, numeral Northeasters with strong winds and high waves visit the region during fall and winter seasons. In addition, the BOEMRE sand and gravel program has collected nearshore information during the 1990's and beyond, which could be incorporated into the synthesis. Given the date of the review and the certain advance in knowledge since then (including several large field programs funded by NSF, NOAA, NASA, NAVO and ONR), a synthesis of knowledge is highly recommended, especially given our limited familiarity with this area. The Navy should be a considerable source for their assessments along the Atlantic coast.

Although BOEMRE has conducted an extensive amount of social science research in the Gulf of Mexico Region, much of this information is not applicable to the South Atlantic coastal region. The south Atlantic coastal area is characterized by many barrier islands and areas highly dependent on recreation or protected Federal or state parks and reserves. Many communities in the region have very limited or no history of offshore energy production. This literature synthesis and associated baseline data will help in understanding these communities and in predicting how they will be able to respond to potential renewable energy development.

In the Atlantic Region, the Environmental Studies Program (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 renewable energy initiatives may result in future renewable energy leasing activity in the Atlantic Region.

Renewable energy projects link to an electricity market that is very different from the petroleum-based industry BOEMRE manages under the OCS Lands Act. These projects will also have very different potential environmental effects and operational needs than do offshore petroleum projects. Based on current expressions of industry interests, BOEMRE expects that most, if not all, Renewable energy projects and activities in the foreseeable future will focus on portions of the BOEMRE OCS Atlantic (Figure 1). These are "frontier areas" with no ongoing renewable energy operations.

The renewable energy industry is rapidly evolving in the face of changing energy markets, technologies, and governmental policies. Wind is of greatest interest currently because of its proven technology. Planning for this future cannot be based on past experience alone. Limited ocean-based renewable energy development has occurred world-wide and this has been primarily wind power, located offshore of Europe.

Objectives: The objectives of this study are:

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

Methods: The location of the study area will extend from Palm Bay, Florida, northward to North Myrtle Beach, South Carolina and includes all Federal marine waters within the US Exclusive Economic Zone (EEZ) and state waters outside of the estuaries. This area includes the BOEMRE's designated South Atlantic planning area. Construction of facilities offshore will have impacts on the coastal environment such as transmission cables and should be included in the literature synthesis.

The data search and synthesis will be a comprehensive search and integration of existing environmental and socioeconomic information for the region. Literature searches shall be conducted to identify, acquire, review, and annotate all environmental, socioeconomic, and technological literature (published and unpublished) for the study area. Information acquisition shall be conducted through computer searches, telephone contacts, library visits, personal contacts, and other means as necessary. This shall be submitted as annotated references. Metadata for each geo-referenced data set shall be submitted. Period of performance is expected to be 28 months, with a deliverable report after 24 months.

Products: Reports, annotated references, and geo-referenced data.

Importance to BOEMRE: The BOEMRE will need updated and synthesized South

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. The recent surge in energy prices and renewable energy initiatives may result in future renewable energy leasing activity in the South Atlantic Region.

Current Status: This effort was awarded September 2009. Task 1 Information Collection is 85% complete; Task 2 Information Synthesis is 50% complete.

Final Report Due:	November 2011
Publications:	None
Affiliated WWW Sites:	None
Revised date:	May 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region:	Gulf of Mexico
Planning Area:	Gulfwide
Title:	Characterization and Potential Impacts of Noise Producing Construction and Operation Activities on the OCS (GM-09-12)
Total Cost: $494,525.35	**Period of Performance:** FY 2009-2011
Conducting Organization:	JASCO Applied Sciences
BOEMRE Contact:	Dr. Donald (Tre) Glenn

Description:

Background: The renewable energy industry is rapidly evolving in the face of changing energy markets, technologies, and governmental policies. Currently wind is of greatest interest because of its proven technology, however planning for this future cannot be based on past experience alone. Limited ocean-based renewable energy development has occurred world-wide and this has been primarily wind power, located offshore of Europe.

Renewable energy projects link to an electricity market that is very different from the petroleum-based industry BOEMRE manages under the OCS Lands Act. These projects will also have very different potential environmental effects and operational needs than do offshore petroleum projects. Based on current expressions of industry interests, BOEMRE expects that most, if not all, renewable energy projects and activities in the foreseeable future will focus on portions of the BOEMRE Atlantic OCS. These are "frontier areas" with no current renewable energy operations.

The construction of offshore renewable facilities will ultimately introduce a considerable amount of noise into the marine environment for some period. To better understand the cumulative effects of noise from renewable construction and development activities on the OCS, the BOEMRE will conduct a study to characterize all aspects of noise-producing activities, such as pile driving, during the construction and operation of an offshore wind facility.
The impacts from pile driving result in substantial noise energy transmission within the water column. The BOEMRE needs to understand the zone of influence from sound generated by these activities as well as measure existing ambient noise levels in order to determine potential impacts (behavior, number of species present during activities, etc.) to marine mammals, sea turtles, fish, and the surrounding habitats.

Objectives: The objectives of this study are: (1-Baseline Data) to identify and characterize the levels and sources of ambient noise (both man-made and natural) in surrounding waters within the areas of concern (to be determined by the BOEMRE) prior

to construction of an offshore wind facility; and (2-Option Phase II) to field-measure actual levels of underwater noise generated during the construction and operation of the facility and to estimate the potential impacts (behavior, number of species present during activities, etc.) to the species present in the area as determined from analyses of the ambient acoustic data (Baseline Data). In addition, signal acquisition, detection, processing, and identification would be required for entire project (Baseline Data and Option Phase II).

Methods: The location of the study area will be determined by the BOEMRE but will be in two (2) of the locations below and within the Atlantic OCS Planning Area Boundaries.

The areas for possible collection to be determined by BOEMRE (2 areas minimum):

1. Horseshoe Shoal off the coast of Cape Cod
2. Offshore New Jersey / Delaware
3. Offshore Rhode Island
4. Offshore Georgia
5. Offshore South Carolina / North Carolina
6. Offshore Florida

The period of performance (POP) is anticipated to be twenty-four (24) months for the Baseline Data (at least one year data collection and analyses) and thirty-six (36) months for the Option Phase II after awards (at least one year data collection during construction and operation; then analyses), for a total of 60 months if the Option Phase II is exercised. The POP will encompass all tasks from initial planning, through and including the BOEMRE's final acceptance of all deliverables.

Products: Field work, data acquisition and storage, published report(s).

Importance to BOEMRE: The study will characterize both specific sources of noise from BOEMRE-permitted actions associated with the construction and operation of an offshore wind facility, as well as ambient noise measurements on the Atlantic OCS. Major noise-producing activities will be identified, and may include activities in addition to pile driving, and measurements of noise from these activities will be recorded and reported in appropriate units of measurement to estimate the acoustic footprint of the activities' duration, frequency, intensity, and relative contribution to ambient noise levels. These data will help quantify the relative contribution to ambient noise levels and consequently, the potential impact(s) to marine resources from the introduction of sound into the marine environment.

Current Status: This effort was awarded November 2009. The acoustic recorders off Delaware Bay and Nantucket Sound were retrieved and redeployed (June-October 2010; October 2010-January 2011). The first and second data sets are being analyzed for the data synthesis report.

Final Report Due: October 2011 (1-Baseline Data)

Publications: None

Affiliated WWW Sites:	None
Revised date:	February 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Sperm Whales and Bottlenose Dolphins in the Gulf of Mexico (GM-11-03)

Planning Area: Gulfwide

Total Cost: $2,700,000 **Period of Performance:** FY 2011-2015

Conducting Organization: NOAA, National Marine Fisheries Service

BOEM Contact: Dr. Deborah Epperson

Description:

Background: The Gulf of Mexico has a diverse marine mammal community. All marine mammal species are protected under the Marine Mammal Protection Act (MMPA) and the sperm whale, an endangered species, is also protected by the Endangered Species Act (ESA). The potential impacts of oil and gas activities are subject to thorough reviews by the National Marine Fisheries Service, Fish and Wildlife Service and Marine Mammal Commission.

Earlier work by BOEM was conducted in the northern GOM and provided information on sperm whale population structure, genetics, movements, and response of whales to anthropogenic industry activities. However, there were limitations to this study. The study area was primarily focused in the region between Mississippi Canyon and De Soto Canyon, although one cruise was conducted in the northwest Gulf. This region has extensive human activity in the form of marine transportation, recreational activities, commercial and recreational fishing, oil and gas activities, and other anthropogenic disturbances. Limited observations from areas outside the northern GOM may mean that previous results may not include variations, if any, in behaviors associated with other geographic regions in the Gulf, particularly sperm whale populations found off the south west coast of Florida, in the Dry Tortugas region.

Coastal bottlenose dolphin stocks are recognized as communities that exist as functioning units of the ecosystem and under the MMPA must be maintained as such. Genetic data supports separate identification of these stocks from other groups occurring in other GOM waters. The stable patterns of residency observed within these coastal dolphin communities suggest that long periods would be required to repopulate the home range of a community were it eradicated or severely depleted. The potential impacts from the DWH incident and the ongoing Unusual Mortality Event (UME) could result in depletion of some coastal bottlenose stocks. An effective management strategy for these stocks would be the protection of the long-term resident communities, with their multi-generational geographic, genetic, demographic and social stability. These localized units

would be at greatest risk from geographically-localized impacts (e.g. oil spills).

Objectives: *Sperm Whales in the Eastern GOM*. This study will focus on obtaining data about populations of sperm whales from less anthropogenically "impacted" areas in the eastern GOM. It will provide baseline information about a population of sperm whales prior to any industry activities and will provide valuable insights into potential effects of industry activities on a relatively "naïve" population. Sightings of sperm whales near the Dry Tortugas and off the southwestern coast of Florida have occurred consistently over many years of vessel based visual surveys of the region conducted by SEFSC. It is unknown whether these animals represent a distinct social or population unit from those occupying the north-central Gulf of Mexico or adjacent Atlantic populations. Animals occurring near the Dry Tortugas region have not been exposed to intensive seismic surveys or other oil and gas industrial activities and a study similar to the Sperm Whales Seismic Study (SWSS) in this region will provide information useful for comparison with the SWSS results from the northern GOM.

Study objectives are:

1. This study will focus on an area with little to no energy industry activity, offshore from southwestern Florida. Data collected in this study will be similar to those data collected in SWSS (see description of work below) and will include a detailed characterization of sperm whales in terms of sex and age distribution, genetic profiles, habitat use, and seasonal movement patterns.
2. Research vessels, moored acoustic monitoring units, and remote sensing tools will also be used to obtain ambient noise measurements and physical oceanographic data to allow a detailed habitat characterization – mapping of both physical oceanographic features and ambient underwater noise levels will be correlated to sightings and acoustic detections of sperm whales and other cetaceans.
3. A subset of whales will be tagged using location only satellite tags (S-tags), time-depth recording GPS tags (TDR-tags), or short duration D-tags to document seasonal movements, habitat use, foraging strategies and potential mixing with northern GOM and/or West Atlantic populations.

Bottlenose Dolphins in the Northern GOM. Bottlenose dolphins in the Gulf of Mexico consist of a complex suite of oceanic, continental shelf, coastal, and estuarine stocks. There are currently 37 defined stocks of bottlenose dolphins, and this includes 32 groups of resident animals within various Bays, Sounds, and Estuaries (BSE). Bottlenose dolphins are exposed to a wide variety of anthropogenic stressors including bycatch in commercial fisheries, exposure to pollution from industrial uses, military activities, and noise and other impacts from oil and gas operations. In addition, there are persistent and repeated Unusual Mortality Events (UME) of bottlenose dolphins in the northern Gulf, and these are most typically associated with Harmful Algal Blooms (HABs). There is an ongoing UME of bottlenose dolphins in the northern Gulf that began just prior to the DWH event and overlaps spatially and temporally with the potential impacts from DWH oil and response activities. Assessing the impacts of both anthropogenic and environmental stressors on these stocks is difficult due to a lack of adequate assessment

information and limited understanding of the relatedness, seasonal movements, and population structure amongst these stocks. Therefore, this study will focus on collecting data that will support effective definition and delineation of stocks to improve the ability to quantify impacts.

Study objectives are to:

1. conduct field studies to collect skin and blubber samples from target estuarine and coastal stocks of bottlenose dolphins;
2. assess the population structure of bottlenose dolphins stocks using a combination of mitochondrial and nuclear DNA markers;
3. conduct stable isotope studies from skin samples to assess trophic status and relationships; and
4. analyze contaminants within blubber samples from targeted stocks to assess environmental exposure to pollutants.

Methods: *Sperm whales in the Eastern GOM*. Population size and seasonal occurrence will be assessed using a combination of moored passive acoustic monitoring units and vessel-based visual and passive acoustic survey. Sperm whales are an ideal species for assessment using passive acoustic tools because they predictably produce broad-band echolocation clicks at regular intervals during dives. As such, they are easily identifiable in acoustic records, and the consistent rate of sound production lends itself to estimation of local density of animals within the detection range of a unit, based upon counts of echolocation clicks received. High frequency acoustic recording packages (HARPs) developed by the Scripps Institution of Oceanography (SIO) are bottom-mounted acoustic units that sample wide band-widths (frequencies up to 100 kHz) for deployments of up to 6 months at a time. In addition to detections of sperm whale sounds, HARPs will also provide detections and recordings of beaked whales, pygmy and dwarf sperm whales, baleen whales, and small delphinids within a 3-5 mile detection range around the unit. With regard to sperm whales, in addition to echolocation clicks, "buzzes", that are associated with feeding behavior, can be detected and quantified as a measure of foraging, and "codas", which are thought to be identification calls, may also be detected.

As part of the NRDA effort associated with the DWH event, one HARP unit has been deployed near the Dry Tortugas since late July, 2010. This unit may remain in place through February 2012. In this project, we would augment that unit with the placement of two additional HARPs in the southwestern Florida/Dry Tortugas region. The units would be deployed as soon as possible (likely in late 2011) and would be maintained continuously through the duration of the project (18-month recording period). Analyses of the data collected from the units will provide a continuous record of the occurrence and density of sperm whales and other marine mammals within this region.

Visual and towed-array passive acoustic data on the occurrence and spatial distribution of sperm whales and other marine mammals will be conducted during summer 2012 aboard the NOAA ship *Gordon Gunter* in conjunction with a sperm whale tagging and biopsy

effort (described below). Directed visual surveys will augment and confirm the detections from the HARP units as they will provide a broader spatial scale assessment of sperm whale and other marine mammal abundance and spatial distribution. In addition, visual confirmation of species identification along with simultaneous collection of recordings from a towed array improves the ability to confirm species identifications from the acoustic signals recorded on the HARPs. Visual surveys will be conducted following standard procedures used during marine mammal assessment cruises by the SEFSC. Simultaneous with the visual effort, a towed hydrophone array will be used to collect broad-band acoustic data from encountered species.

Population genetics and demographics will be studied during the summer 2012 large vessel survey. When sperm whales are encountered during the survey, a 7-meter, rigid-hull, inflatable boat (RHIB) will be deployed to conduct close approaches. During these encounters, close approaches will be made to collect photographic data and biopsies of skin and blubber. Stereoscopic photographic methods or similar approaches will be used to collect measurements of the sizes of encountered animals. As opportunities allow, photo-identification images of whale flukes will also be collected that will allow for the development of a catalog of identified individuals using this region. Tissue samples will be collected from the small vessel using a specially designed dart and 0.22 caliber rifle. The dart is designed to penetrate a short distance into the animal and extract a sample containing skin and blubber. A portion of the skin will be stored for genetic analyses (i.e., sex and population structure), and a portion will be stored for stable isotope analyses (an indicator of trophic level status). Blubber will be stored at minus 80°C and may be used for a variety of analyses including contaminant loads, fatty acid signatures, and reproductive hormones. Finally, during close approaches sperm whale scat may be collected opportunistically which can provide information on prey through either genetic probes or identification of hard parts from squids and/or fish.

A subset of the sperm whales encountered during the summer 2012 vessel survey will be tagged with either location-only satellite tags (S-tags), time-depth recording GPS tags (TDR-tags), or short-duration, suction-cup, digital tags (D-tags). Used together, the different tags will provide information on long-term (~12 months), on-the-surface movements (S-tags), dive-surface behavior over 30-45 days (TDR tags), and intensive dive and feeding behavior over scales of hours (D-tags). Tagging operations will consist of first identifying animals through either visual sighting or passive acoustic arrays. Ancillary data (e.g., from aerial surveys) may also be used to locate whales during the tagging phase of the cruise. When whales are located, a rigid-hulled inflatable (RHIB) will be launched to approach and sample/tag whales. The tagging vessel crew of 3 persons will consist of a driver, a tagger/biopsy person, and a photo ID person. At a minimum, whales will be photographed and biopsy samples taken. Satellite tags will be deployed using an air-powered applicator at close range (<= 3 m). Animals to be tagged will be determined by selection criteria that exclude calves, small juveniles, and any signs of animals being compromised (such as emaciated whales). Tags will be deployed near the mid-dorsal line and within several meters anterior of the dorsal hump with a preferred vertical antenna orientation. The satellite tags will be scheduled to transmit based on optimum data collection and extended tag duration. TDR tags are deployed in a similar

manner to S-tags; however, they record dive behavior over a 30- to 45-day cycle and transmit short summaries of dive activities over the Service ARGOS system. Detailed dive records are recorded on the TDR tags, which must be recovered after they detach to obtain their full data sets. Finally, as opportunity allows, suction-cup D-tags will be deployed to provide intensive, short-term information on whale swimming behavior, vocalization patterns, feeding attempts, and received sound.

Location data from the HARPs, visual surveys, and tags will be used to characterize sperm whale movements, density, and habitat use. The habitat will be characterized through a combination of remotely sensed surface physical data (e.g., chlorophyll concentration, sea surface height, geostrophic currents, and sea surface temperature) and continuous underway sampling of surface waters during the vessel survey. In addition, hydrographic profiles of salinity and temperature will be conducted during the survey to depths up to 1,000m using conductivity temperature depth (CTD) profilers and/or expendable bathythermographs (XBT). Furthermore, scientific echosounders operating at frequencies of 18, 38, and 120 kHz will be used throughout the survey to provide data on acoustic backscatter as an indicator of the biomass of plankton and micronekton within the surveyed area.

Bottlenose Dolphins in the Northern GOM. This study will provide information on the population structure, seasonal movements, and exposure to contaminants of selected coastal and estuarine bottlenose dolphins stocks. Stocks selected for study will not be those currently being evaluated as part of the Natural Resource Damage Assessment (NRDA) investigations. The planned NRDA studies focus on stocks in Mississippi and Louisiana, and there are complimentary studies currently planned for the panhandle and west coast of Florida. Therefore, it is most likely that the studies planned here will focus on the western Gulf of Mexico, including along the coasts of southern Louisiana and Texas. The continental shelf immediately offshore of these areas has high levels of oil and gas activity.

Bottlenose dolphin biopsy tissue samples will be collected from a small boat using techniques similar to those described above for sperm whales. Sampling efforts will be conducted during at least two seasons (summer and winter), at up to four sites. At each site, samples will be collected both within estuarine waters and in adjacent coastal waters during the same season. This allows a direct assessment of whether or not bottlenose dolphins within an estuary are genetically distinct from those immediately offshore. Seasonal comparisons will assess whether or not estuarine dolphins are year-round residents of estuarine habitats and evaluate potential seasonal movements of offshore stocks. Sampling will be conducted by a dedicated team of four staff operating from a small boat. Target sample sizes within each seasonal sampling effort will be 30 samples from each habitat (coastal and estuarine). Biopsy samples will be handled using clean techniques in the field and stored as appropriate for the genetic analysis of skin and the contaminant analysis of blubber.

Skin samples from biopsies will be analyzed genetically for gender determination and evaluation of population structure. Knowledge of the sex of each sample is integrated into

the genetic analyses to test for evidence of sex-based dispersal rates among populations. Mitochondrial DNA (mtDNA) has proven an effective marker for stock discrimination in marine mammals. Analysis of mtDNA data provides an estimate of the degree of movement and genetic exchange of females, an important measurement for species such as bottlenose dolphins that exhibit a high degree of female site fidelity. To examine the contribution of both males and females to genetic exchange rates, we will also analyze 19 independent nuclear microsatellite loci tested and optimized for a wide range of common bottlenose dolphin populations in the Gulf of Mexico and western North Atlantic. The microsatellite data can also be used for individual identification of dolphins, which will support the photo-identification and tagging work. Analysis of both mitochondrial and nuclear markers will provide a measure of the degree of interbreeding among these populations. Analysis of mitochondrial DNA and nuclear microsatellite markers will use standard methodologies and will utilize samples collected from up to four estuarine sites targeted during the biopsy efforts.

Blubber samples can be analyzed for a variety of contaminants and samples will be used for quantitative polymerase chain reaction (qPCR) analysis to determine cytochrome P4501A (CYP1A) protein expression as a biomarker for oil-related contaminant (polycyclic aromatic hydrocarbon) exposure. Remaining blubber will be used for the analysis of reproductive and stress hormones, as well as for the chemical analysis to determine the levels of other contaminants such as polychlorinated biphenyls which may cause increases in CYP1A.

Products: The primary objective of this IA is to collect and analyze data to provide BOEM with information on sperm whales in the eastern GOM and coastal bottlenose dolphins in the northern GOM. The NMFS will provide quarterly letter reports that address progress and problems for each of the study objectives noted in the goals and objectives above. Periodic updates will be provided as requested.

Importance to BOEM: The exploration and development of oil and gas resources in the Gulf of Mexico (GOM), as well as potential renewable energy and alternate use projects, will require BOEM to produce information for a variety of NEPA documents as well as Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) compliance. Recent mandates to offer offshore leases within 125 miles of the west coast of Florida as well as the Deepwater Horizon (DWH) spill incident prompt the need for BOEM to investigate and better understand protected marine mammal resources.

Current Status: ongoing

Final Report Due: December 2014

Publications: None

Affiliated WWW Sites: None

Revised date: October 2011

ESPIS **ESPIS** - All ***completed*** ESP Studies:

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Gulfwide

Title: Sperm Whale Acoustic Prey Study (SWAPS) (GM-09-05)

Total Cost: $550,000 **Period of Performance:** FY 2009-2012

Conducting Organization: NOAA, National Marine Fisheries Service

BOEMRE Contact: Dr. Deborah Epperson

Description:

Background: Sperm whales (*Physeter macrocephalus*) in the northern Gulf of Mexico (GOM) are protected by both the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). Sperm whales are present throughout the GOM year-round. Preliminary results from several studies of genetics, size distribution, and acoustic behavior suggest that this population is distinct from others in the North Atlantic Ocean (Waring *et al.* 2008). The most recent abundance estimate for the portion of the stock residing in the northern GOM (within the U.S. Economic Exclusivity Zone (EEZ)) is 1,665 animals (coefficient of variation = 0.20, Mullin 2007). Based upon this abundance estimate the annual number of human caused mortalities that can be sustained by the stock without threatening its recovery (*i.e.* Potential Biological Removal or PBR) is 2.8 animals (Waring *et al.* 2008).

The northern GOM is one of the most heavily industrialized bodies of water in the world and is the site of intensive energy exploration and exploitation. There are approximately 4,000 offshore oil platforms and 25,000 miles of active oil and gas pipeline on the GOM sea floor with the majority of these resources concentrated on the continental shelf and continental shelf break west of the Mississippi River. In addition, there is extensive and ongoing exploration of the Gulf for additional energy resources over continental slope waters. These exploration activities typically employ air-gun arrays that radiate high intensity, broad-band frequency sounds. These noise sources may result in behavioral or physiological impacts to protected marine mammals, including sperm whales. As a result, BOEMRE has sponsored numerous studies of sperm whale abundance, spatial distribution, habitat, and response to sound sources since the 1990's. The most recent of these studies was the Sperm Whale Seismic Study (SWSS) which conducted fieldwork between 2002 and 2005 to develop baseline information on the biology and behavior of sperm whales, characterize habitat use, and assess changes in behavior associated with exposure to sounds from seismic air-guns (Jochens *et al.* 2008).

Analyses of sperm whale spatial distribution during the first two years of the SWSS cruises (2002 and 2003) and from prior studies in the summers of 2000 and 2001 demonstrated a strong relationship between sperm whale occurrence and mesoscale

physical features. Most notably, Loop Current eddies and cyclonic circulation along the 1,000 m isobath in the central northern GOM resulted in off-margin flow and locally elevated surface chlorophyll concentrations. Under these conditions of elevated surface layer primary productivity, there were localized high densities of sperm whales (Biggs et al. 2005). Localized acoustic studies of sperm whale distribution during the SWSS studies demonstrated that areas of high sperm whale concentration were also related to elevated levels of back-scatter from scientific echosounders as an indicator of the biomass of prey resources at depth.

Diving studies conducted during SWSS demonstrated that the depth range between 400-600m was most consistently associated with sperm whale dives and acoustic behavior consistent with feeding. Data from scientific echosounders (70 kHz and 38 kHZ Simrad EK60) indicate two primary scattering layers in regions where feeding sperm whales were observed. The first consisted of vertically migrating organisms that are at depths between 350-550 m during the day that rose rapidly to the surface layer at night. The second layer is more horizontally patchy, but had high backscatter levels during both day and night hours at depths greater than 500 m (Jochens *et al.* 2008). Based on foraging dive depths, sperm whales apparently feed near the bottom of the primary scattering layer during the daylight hours and near the top of the secondary deep scattering layer at night.

The actual species composition of sperm whale prey in both scattering layers is not known, and there has been little systematic study of the deep and mid-water pelagic community of the northern GOM. The diets of sperm whales globally are presumed to be dominated by mid-water squid species (Clarke *et al.* 1993). A study of sperm whale stomach contents from the Azores found that the modal mass of individual squid was between 400-500 g with most taxa typically having mantle lengths between 100 – 300 mm (Clarke *et al.* 1993). A study of sperm whale diets inferred from both stranded animals and fecal collections in the northern GOM found a similar size range and species composition to that of the Azores study. Sperm whale diets included squid prey from 13 species within 10 families, and squids were the only prey type observed. The diets were dominated by Histoteuthid squids that were inferred to have a mean mantle length of 80 mm (range: 60-90 mm) and an average mass of 194 g (range: 99-303 g, Barros 2003). There are two species of Histoteuthid squids documented in the northern GOM. Both species occur throughout the water column from the surface to 2,000 m and have varying degrees of vertical migration (Voss *et al.* 1998). However, it should be noted that these data are from a very small sample size collected in a localized area, and may not fully reflect the diversity of sperm whale prey in the Gulf.

Objectives:

The goal of this study is to characterize the species composition and biomass of mid-water squid and small pelagic fish in the GOM that represent the apparent forage base for sperm whales. Acoustic backscatter provides a high resolution picture of the vertical and horizontal distribution of secondary productivity. However, the actual composition of the prey may vary significantly and may not be reflected in the backscatter. Similarly, the return from the 38 kHz echosounder may represent plankton and micro-nekton that are the prey of mid-water squids, rather than the squids themselves. To better characterize

the forage base for sperm whales in the Gulf this study will:

- Conduct quantitative sampling of the mid-water pelagic community within the foraging depths of sperm whales,
- Examine the relationships between acoustic backscatter and prey taxonomic composition, and
- Compare sperm whale distribution and prey composition across habitats of the northern GOM.

The quantitative sampling of the mid-water squid and fish community is a significant challenge. There are relatively few studies of this community in the global oceans, reflecting the difficulty in efficiently catching these relatively large and fast-moving prey. A pilot study was conducted during the summer of 2009 in association with a marine mammal assessment survey aboard the NOAA ship *Gordon Gunter*. The primary goal of the pilot study was to develop fishing methods using a large mid-water trawl to target specific layers of prey apparent in the acoustic backscatter data. A dedicated cruise was completed on the NOAA ship *Pisces* in January - March of 2010 immediately prior to the Deepwater Horizon (DWH) event. This cruise was a larger scale effort to sample prey both acoustically and with nets while simultaneously quantifying sperm whale distribution and abundance throughout the GOM.

Methods:

The pilot project was conducted during a Marine Mammal Assessment survey between June – August 2009 aboard the NOAA Ship *Gordon Gunter*. The survey covered waters between the 200 m isobath and the U.S. EEZ encompassing sperm whale habitats of the continental shelf break and upper continental slope throughout the Gulf.

The survey data collection included information on sperm whale (and other marine mammal species) spatial distribution and abundance simultaneous with data collected on prey biomass, composition, and spatial distribution. Data on prey composition and biomass was collected with two primary tools: scientific echosounders and a mid-water trawl.

The scientific echosounder aboard the *Gordon Gunter* is similar to that used during the SWSS studies (SimRad EK60). This is a split-beam echosounder with both 38 kHz and 120 kHz frequencies. The echosounder was calibrated both at the beginning and end of the study using targets of known return strength to allow reliable quantification of backscatter. Throughout the survey, echosounder data was collected continually and recorded to hard-disk to provide information on the vertical and horizontal distribution of backscatter on both frequencies throughout the cruise. Finally, the echosounders were used to provide detailed data on the vertical distribution of scattering layers in the presence of foraging sperm whales.

Initial deployment and testing of the gear was conducted during a dedicated 7-day period at the beginning of the survey. The focus of the work was on targeting specific depth

layers (using the scientific echosounder), fishing in those layers, and verifying the effectiveness of the gear at collecting target species. During the remaining 50 days-at-sea of the survey, the primary objective of the cruise was to conduct visual line transect surveys for marine mammals. Additional mid-water trawling was conducted throughout the survey, generally in areas with aggregations of feeding sperm whales. Stations were selected on an adaptive basis and included both day and night sampling across a range of habitats throughout the Gulf such as within or near Loop Current eddies and along the continental shelf break of the eastern, central, and western Gulf. Twenty-five were sampled with the mid-water trawl throughout the survey. Collected squids and other pelagic prey were identified at sea (where possible), measured and weighed, and/or preserved for later identification and evaluation. Vertical profiles of hydrographic parameters were conducted at trawl stations including temperature, salinity, oxygen content, and fluorescence.

Products: The primary objective of the trawling portion of this survey was to develop the methods for quantitative sampling of mid-water prey and to develop preliminary data on the relationships between acoustic backscatter, prey composition and biomass, and sperm whale distribution. The project deliverables will focus on the results of the prey sampling efforts and have resulted in both a cruise report summarizing survey effort, hydrographic sampling, sperm whale sightings, and trawling efforts and a summary report which includes detailed summaries of trawl stations during both the testing and operational phases of the cruise. Following the pilot cruise, a study plan was produced for the winter 2010 survey to assess the relationships between sperm whales and their prey based upon the lessons learned during this pilot study. Data analyses and final report preparation has been delayed due to the DWH event.

Importance to BOEMRE: The potential for acoustic disturbance resulting from seismic industry activities in the GOM is the subject of much debate. The potential effects of seismic exploration on marine vertebrates (cetaceans and sea turtles) and their prey species are largely unknown. The most recent NMFS Biological Opinions (2002, 2003) for lease sales in the GOM have included recommendations that "BOEMRE 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. Before this can be addressed, methodology needs to be developed to accurately identify squid stocks in the GOM.

Current Status: ongoing

Final Report Due: December 2011

Publications: none

Affiliated WWW Sites: none

Revised date: June 2011

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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Planning Area: Gulfwide

Title: Seismic Survey Mitigation Measures and Marine Mammal Observer Reports (GM-08-02)

Total Cost: $150,000 **Period of Performance:** FY 2008-2013

Conducting Organization: GeoCet Group, LLC

BOEM Contact: Dr. Deborah Epperson

Description:

Background: As a result of the 2002 National Marine Fisheries Service (NMFS) Biological Opinion for Lease Sale 184 (western planning area), Bureau of Ocean Energy Management, Regulation and Enforcement (BOEM) implemented a seismic survey mitigation measures Notice to Lessees (NTL). This initial NTL (2002-G07) has subsequently been updated (2003-G08; 2004-G01; 2007-G02) and expanded to include a variety of mitigations and reporting requirements. These measures apply to all on-lease surveys conducted under 30 CFR 250 and all off-lease surveys conducted under 30 CFR 251. Seismic operators in the Gulf of Mexico (GOM) are required to submit reports on the 1st and 15th of each month. Reporting requirements include an observer effort report, survey reports and sightings report. These reports are sent electronically to BOEM through a protected species mailbox (protectedspecies@boem.gov) which is monitored by a protected species biologist in the Leasing and Environment (LE) section. As part of the original Biological Opinion that resulted in the seismic survey observer program, NMFS also required that an annual report be submitted documenting all sightings of sperm whales and sea turtles, the species likely to be sighted currently listed under the Endangered Species Act (ESA). As a result, BOEM now has considerable data from the observer program and is in a position to evaluate existing mitigations and their effectiveness. These data would be timely for both BOEM and NMFS as we proceed through the Marine Mammal Protection Act (MMPA) rulemaking process.

Objectives: The purpose of this study is to summarize and synthesize submitted seismic survey observer reports for the years 2002-2008. After synthesis of these data, recommendations will be made as to the effectiveness of required mitigation measures, as well as suggestions for new and/or improved mitigations.

Methods: Due to the proprietary nature of the reports, this analysis will require close coordination with LE personnel. Working with existing spreadsheets and data, a separate analysis of all three reports (observer effort, survey, and sightings) will be completed. Characterizations of seismic activity levels, species occurrence and behavior, and observer effort are among the types of data that will be analyzed. Additional details about the types of data collected for each report can be found in the latest NTL No. 2007-

G02. http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2007NTLs/07-g02.pdf.

Products: Final report and journal publication.

Importance to BOEM: This study will provide information about the existing seismic survey mitigation program. By a thorough review of all reporting received since the inception of the program in 2002, BOEM will be able to quantify many facets of the program and evaluate its effectiveness. In addition, received data on geophysical activities in the GOM can be compared with projected estimates used in NEPA documents. These data will provide much needed information to both BOEM and NMFS for MMPA and ESA consultations.

Current Status:	Final report is in preparation
Final Report Due:	April 2012
Publications:	none
Affiliated WWW Sites:	none
Revised date:	November 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Gulfwide

Title: The Movement and Habitat Associations of Sea Turtles in the Northern Gulf of Mexico (GM-10-04)

Total Cost: $497,000 **Period of Performance:** FY 2010-2013

Conducting Organization: NOAA, National Marine Fisheries Service

BOEMRE Contact: Dr. Deborah Epperson

Description:

Background: Sea turtles are ubiquitous in the continental shelf and inner slope waters of the northern Gulf of Mexico. All species of sea turtles found in the Gulf of Mexico are federally listed under the Endangered Species Act. The Gulf of Mexico is one of the most heavily industrialized bodies of water in the world. In particular, west of the Mississippi River on the continental shelf, there are extensive oil and gas facilities including thousands of oil and gas platforms. The recent Deep Water Horizon MC252 event has resulted in millions of barrels of oil being released into the Northern Gulf of Mexico. There have been observations of sea turtles within oiled areas, and there may be impacts on turtle populations through direct mortality, chronic exposure, and degradation of nesting beaches. Understanding the extent of the impact on sea turtle populations requires establishing a long-term monitoring strategy for changes in abundance and spatial distribution. A strong understanding of turtle movements and habitat use will facilitate any such monitoring effort. Satellite tag telemetry data provides long-term records of the movements of individual animals and thus provide insight into their habitat use patterns and dive-surface intervals that are useful for correcting abundance estimates derived from visual surveys for the proportion of turtles that are underwater at any given time. Thus, this project will deploy satellite telemetry tags on three species of turtles throughout the Northern Gulf to provide information on movements, habitat use, and dive surface behavior.

Objectives: The goal of this study is to evaluate the habitats, abundance, and spatial distribution of marine turtles occupying continental shelf waters of the northwestern Gulf of Mexico. These data will be used to improve the capability of BOEMRE and the National Marine Fisheries Service to evaluate the status and trends of sea turtles in the Northern Gulf of Mexico and to understand the potential impacts of the DWH MC252 event. The study objective is to use satellite tag-telemetry data to characterize seasonal movement and habitats of turtles and quantify diving behavior.

Methods: This study will focus on sea turtle abundance, habitat, and spatial distribution in the northern Gulf of Mexico between Texas (-97.5°W longitude) and southwestern Florida. The primary target species will be Loggerhead turtles (*Caretta caretta*), Kemp's

Ridley turtles (*Lepidochelys kempii*), and Green turtles (*Chelonia mydas*). These are the most common species encountered throughout the northern Gulf of Mexico, and in particular have been observed in areas impacted by the DWH spill. The study will include tagging of both juvenile and adult turtles from each species within three primary areas of the Gulf of Mexico.

The goal of the study will be to tag 60 turtles within the eastern, central, and western Gulf of Mexico beginning in the spring-summer of 2011. Turtles will be obtained primarily through cooperation with several different research groups that are conducting in-water studies of turtles within the target areas. These sampling programs include relocation trawling, in-water netting, and beach surveys. The tags used will provide records of location, dive depths, and water temperature throughout their approximately 12-month deployment cycle. As precise information on spatial location is required, the tags will employ "FastLoc" GPS capability. These tags transmit data via the ARGOS satellite system and contain sensors for recording of depth, light-level, and temperature. The on-board GPS provides very precise spatial positioning data and tracking of animal movements through time.

Products: NOAA will provide quarterly reports with information on seasonal movements and dive-behavior patterns of sea turtles in the Northern Gulf of Mexico. A final synthesis and summary report will be completed.

Importance to BOEMRE: A previous BOEMRE study of sea turtle association with oil platforms showed seasonal changes in the degree of association with platforms, with less evidence of association during winter months. Changes in spatial distribution may be evident from changes in the locations occupied by tracked animals such as a shift from more nearshore to more offshore habitats. There may also be seasonal changes in the extent of the range used or the daily movement rate of individuals. Finally, the temperature data collected by the tags can be compared to the distribution of available temperatures within the habitat to identify possible preferential selection of particular habitats. These data can then be used for Endangered Species Act Section 7 consultations as well as associated National Environmental Policy Act analyses.

Current Status: ongoing

Final Report Due: December 2012

Publications: none

Affiliated WWW Sites: none

Revised date: June 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Marine Mammal and Sea Turtle Literature Search and Data Synthesis Including Strandings and Nesting Sites (GM-09-x20)

Planning Area: Atlantic

Total Cost: $141,231 **Period of Performance:** FY 2009-2011

Conducting Organization: National Marine Fisheries Service, Northeast Science Center, Woods Hole, MA

BOEMRE Contact: Dr. Deborah Epperson

Description:

Background: The U.S. Atlantic seaboard has not been developed for alternative energy but interest is increasing and several alternative energy projects have been proposed. The U.S. Atlantic harbors a suite of protected coastal and offshore marine organisms including sea turtles, birds, bats, fishes, and marine mammals, many of which are listed as endangered or threatened.

The U.S. Atlantic coast has experienced limited offshore energy development. However, a sizeable body of research on marine mammals and sea turtles has been conducted in these waters. Nesting and stranding events have been systematically recorded in several areas along the Atlantic coast. This research data review and synthesis will provide a foundation for environmental assessment and determination of potential impacts to marine mammals and sea turtles from energy development and production activities.

Objectives: The objectives of the study are:

- Review of pertinent research and literature, including previous BOEMRE studies, and
- Publication of a report on the findings of recent research and, by synthesis of available information, a characterization of marine mammal and sea turtle diversity, distribution, abundance, and seasonality along the U.S. Atlantic Seaboard from Maine to Florida.

Methods: This project will involve a comprehensive literature search and integration of findings with existing environmental information for the region.

Products: Final Report

Importance to BOEMRE: The BOEMRE will need updated and synthesized Atlantic OCS information on marine mammals and sea turtles of the region in order to meet its responsibility of ensuring that all OCS activities, specifically alternative energy, are conducted in an environmentally responsible manner. The proposed study will provide up-to-date information on species composition, distribution, abundance, and seasonal variation of marine mammals and sea turtles along the Atlantic coast. Nesting sites of sea turtles and strandings of all species should be included. Data generated will be used for environmental review of projects proposed in Atlantic waters.

Current Status: ongoing

Final Report Due: August 2011

Publications: None

Affiliated WWW Sites: None

Revised date: May 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Deep-Water Reconnaissance of Potentially Sensitive Biological Features (PSBF's) Surrounding Shelf-Edge Topographic Banks in the Northern Gulf of Mexico (GM-11-01a)

Planning Area: Central and Western

Total Cost: $252,294

Period of Performance: FY 2011-2015

Conducting Organization: NOAA, Flower Garden Banks National Marine Sanctuary

BOEMRE Contact: James Sinclair

Description:

Background: The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) Notice To Lessees 2009-G39 describes protection for Potentially Sensitive Biological Features (PSBF's). These are seafloor features in the Gulf of Mexico (GOM) with moderate to high relief (about 8 feet or higher) that provide valuable habitat for benthic species and serve as Essential Fish Habitat. They are not covered by the biological stipulations on Leases. They provide surface area for the growth of sessile invertebrates and attract large numbers of fish. Habitat utilization of these features is expected to vary depending on physical parameters including relief, size, habitat complexity, association with other features (as in trends or systems of features), water quality, turbidity, depth, and temperature.

The BOEMRE has become aware of PSBF's from its large database of bathymetric surveys and from USGS multi-beam surveys. These features are protected from direct physical impacts of oil and gas activities based on bathymetry provided with permit applications. However, the benthic and fish communities of these features are relatively unknown. Of particular concern are multiple features known to exist in the vicinity of protected topographic features along the shelf-edge of the northern GOM. Available seafloor surveys suggest that these PSBF's support high diversity benthic communities similar to the lower levels of the protected banks. Significant areas of these features occur outside the bank No Activity Zones. The BOEMRE needs to investigate these PSBF's to characterize their benthic and fish communities and define their distribution. Bathymetric data alone does not describe the quality and sensitivity of this ecosystem. This information is required to ensure that the BOEMRE properly protects these valuable resources which are a significant component of the wider ecosystem.

The Deepwater Horizon oil spill on April 20, 2010, in block MC252, approximately 50

miles southeast of Venice, Louisiana, released millions of gallons of crude oil in the north-central GOM. The oil release was treated with dispersants both at the sea's surface and subsea (at about 5000 ft of water depth). The dispersed oil weathers, biodegrades, clumps, and eventually sinks to the seafloor. In this manner, the oil could be distributed widely over a large area of the seafloor and could directly affect hard bottom communities.

This study is designed as an adaptive approach to management and may result in revision of BOEMRE No Activity Zone boundaries. The BOEMRE needs to characterize these features across the entire northern GOM. This study will begin that process by examining notable PSBF's known to exist near important topographic features along the shelf-edge. We will also assess the impact and recovery of these ecosystems to possible effects of oil from the Deepwater Horizon spill. Recent USGS work has provided high resolution multi-beam bathymetry around numerous shelf-edge topographic features in the northern GOM. In addition, the Flower Garden Banks National Marine Sanctuary (FGBNMS) has conducted several ROV surveys around a few of the banks. This study will be carried out in cooperation with the Louisiana Universities Marine Consortium (LUMCON), the FGBNMS, and the University of North Carolina Wilmington (UNCW).

Objectives: The objective of this study is to provide the BOEMRE with information needed to evaluate the quality and sensitivity of known PSBF habitats near protected topographic features, relate them to the wider ecosystem, and assess possible oil impacts/recovery.

Methods: This study will characterize both the physical and biological components of PSBF's near shelf-edge banks. The study will incorporate available information for these features and conduct field investigations to gather new information. In addition, sediment and tissue samples will be analyzed for effects from the Deepwater Horizon oil spill. The study will focus on representative areas of PSBF's around protected topographic features along the edge of the GOM continental shelf from the Flower Garden Banks to Jakkula Bank. Sampling sites will be selected to produce a representative description of features in this area. Work already done by the FGBNMS will be incorporated and supplemented to maximize our results. That work includes numerous ROV surveys at several shelf-edge banks. New information will be gathered with additional ROV surveys, water quality instrumentation, and sampling of benthic and fish components (including contaminants analyses). Semi-Permeable Membrane Devices may be deployed at each sampling site if continued deposition of oil is suspected. Other methods may be employed as available and appropriate, including SCUBA, AUV, submersibles, benthic samplers, and camera systems.

Products: Final Report, archive of still and video imagery, GIS files, data files, peer-reviewed scientific article.

Importance to BOEMRE: The BOEMRE needs to describe the character of Potentially Sensitive Biological Features (PSBF's) in the shelf-edge region of the northern Gulf of Mexico to establish baseline conditions, enhance identification of sensitive habitats, and ensure adequate protection. Potential impacts and recovery from the Deepwater Horizon

spill should be assessed.

Current Status: Awarded

Final Report Due: July 2015

Publications: none

Affiliated WWW Sites: http://geopubs.wr.usgs.gov/open-file/of02-411/index.html

http://www.ncddc.noaa.gov/website/google_maps/FGB/mapsFGB.htm

Revised date: August 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Improving the Predictive Capability of 3D Seismic Surface Amplitude Data for Identifying Chemosynthetic Community Sites (GM-92-42-76)

Planning Area: Central

Total Cost: $799,000 **Period of Performance:** FY 2000-2011

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEMRE Contact: Dr. Mary C. Boatman

Description:

Background: Bureau of Ocean Energy Management, Regulation and Enforcement is responsible for protecting sensitive biological communities on the Outer Continental Shelf from destruction by oil and gas activities. Exploration and development plans are reviewed to determine whether activities are within close proximity to sensitive communities. The location of the community is often determined from surface seismic data since most communities are located on relatively hard surfaces which result in a different response than surrounding sediments during the collection of seismic data. In particular, the unique chemosynthetic communities found in the Gulf of Mexico are associated with outcrops of gas hydrate, which forms a hard surface and therefore can be identified from seismic data. The data, however, is open to interpretation and may result in mitigations being applied to areas where there are no sensitive communities.

Bureau of Ocean Energy Management, Regulation and Enforcement has access to all the seismic data collected from the Gulf of Mexico, which is not available to any other single entity. Recently, surface seismic data and underlying geologic structures have been synthesized for a more complete interpretation. However, this data will need further groundtruthing to verify that the geologic criteria are interpreted correctly.

This study involves a joint effort between BOEMRE personnel in the Resource Evaluation Section, Field Operations, and Leasing and Environment with an LSU investigator. The seismic information will be interpreted by both BOEMRE and LSU personnel and further investigated by visual confirmation using a submarine for shallow depths and an ROV for greater depths. The results will be used to better interpret seismic data and fine tune mitigations during reviews of chemosynthetic community locations.

Objectives: The objectives of this study are to define criteria for the surface expressions of hydrates and to verify that the criteria are valid.

Methods: Bureau of Ocean Energy Management, Regulation and Enforcement and LSU personnel will review and interpret in house seismic data to identify sites where hydrates

are expected as well as sites where they are not and develop geologic criteria these sites. A submarine will be used to investigate sites that are less than 1000 m., while an ROV will be used to visit sites at greater depths. The visual observations will be synthesized with the geologic criteria to better define interpretations of data submitted in plans and application of mitigations.

Products: A final report, pictures, and videos of the locations investigated.

Importance to BOEMRE: The BOEMRE has historically provided protection from impacts to physically and biologically sensitive offshore bottom features, such as chemosynthetic communities, by preventing activities within a defined distance of the bottom feature. Information from this study will be useful in better interpreting data supplied by offshore operators to establish zones of no activity.

Current Status: A draft of the final report was received and reviewed. The PI is making revisions and additions. The next draft is expected in March 2011.

Final Report Due: December 2006

Publications:

Chen, D.F., L.M. Cathles, III, and H.H. Roberts, (2004), The geochemical signatures of variable gas venting at gas hydrate sites: marine and Petroleum Geology, v. 21, p. 317-326.

Sassen, R., H.H. Roberts, R. Carney, A.V. Milkov, D.A. DeFreitas, B. Lanoil, C. Zhang, (2004), Free hydrocarbon gas, gas hydrate, and authigenic minerals in chemosynthetic communities of the northern Gulf of Mexico continental slope: relation to microbial processes. Chemical Geology, v. 205, p. 195-217.

Sassen, R., A.V. Milkov, H.H. Roberts, S.T. Sweet, and D.A. DeFreitas, (2003), Geochemical evidence of rapid hydrocarbon venting from a seafloor-piercing mud diapir, Gulf of Mexico continental shelf: Marine Geology, v. 198, p. 319-329.

Rogers, R.E., J.L. Dearman, and H.H. Roberts, (2003), Enhancement of gas hydrate formation in Gulf of Mexico sediments: Proceedings, Offshore Technology Conference, OTC 15393, p. 1-7.

Roberts, H.H., J.L. Hunt, W.W. Shedd, and R. Sassen, (2002), Surficial gas hydrates, part of the fluid and gas expulsion response spectrum: Identification from 3D seismic data: Proceedings Offshore Technology

Conference, OTC 14033, May 6-9, 2002, p. 1-10.

Roberts, H.H., R. Sassen, and A.V. Milkov (2001) Seafloor expression of fluid and gas expulsion from deep petroleum systems, continental slope of the northern Gulf of Mexico: 2001 GCSSEPM research Foundation, 21st Ann. Res. Conf., Petroleum Systems of Deep-Water Basin, p. 407-421.

Roberts, H.H., (2001), Fluid and gas expulsion on the northern Gulf of Mexico continental slope: Mud-prone to mineral-prone responses. *In:* C.K. Paull and W.P. Dillon (eds.), Natural gas hydrates: Occurrences, distribution, and dynamics: American Geophysical Union, Geophysical Monograph, No. 124, p. 145-161.

Sassen, R., H.H. Roberts, A.V. Milkov, and D.A. DeFreita (2001) Seafloor vents, seeps, gas hydrate: Relation to flux rate from the deep Gulf of Mexico petroleum system: 2001 GCSSEPM Research Foundation, 21st Ann. Res. Conf., Petroleum Systems of Deep-Water Basins, p. 489-505.

Roberts, H.H., J.M. Coleman, J. Hunt, Jr., and W.W. Shedd, (2000), 3D-seismic surface amplitude mapping for unproved interpretation of seafloor geology and biology: Offshore Magazine, September Issue, p. 126-128, 181.

Roberts, H.H., J.M. Coleman, J. Hunt, Jr., and W.W. Shedd, (2000), Surface amplitude mapping of 3D-seismic for improved interpretations of seafloor geology and biology from remotely sensed data: Transactions Gulf Coast Association of Geological Societies, v. 50, p. 495-504.

Presentations at Local, Regional, National, and International Meetings:

Roberts, H.H., J.L. Hunt, Jr., and W. Shedd, 2005, Seafloor and subsurface geology of gas hydrate sites—northern Gulf of Mexico continental slope: SGS Geophysical Symposium, New Orleans, LA, June 9 (Poster).

Roberts, H.H., 2004, Gas hydrates in the Gulf of Mexico's complex geologic setting: Future resource or just another geohazard? Houston Geological Society, Houston, TX, April 28, (Invited Talk).

Roberts, H.H., J.M. Coleman, J.L. Hunt, Jr., W.W. Shedd, and R. Sassen, 2003, Seafloor and subsurface geology of

gas hydrate exposure sites-Northern Gulf of Mexico Continental Slope: American Association of Petroleum Geologists Annual Meeting, Official Abstract Volume, p. A146 (Poster).

Roberts, H.H. and J.M. Coleman, 2003, Improving the predicitive capability of 3D-seismic surface amplitude data for identifying chemosynthetic communities: MMS-Information Transfer Meeting, Jan. 14-16, New Orleans, LA. (Talk).

Roberts, H.H., J.M. Coleman, and H. Peele, 2003, Mapping areas of hard bottom and other important bottom types-outer continental shelf and upper continental slope (northern Gulf of Mexico): MMS-Information Transfer Meeting, Jan. 14-16, New Orleans, LA. (Talk).

Sassen R., H.H. Roberts, J.P. Chanton, A.V. Milkov, D.A. DeFreitas, and S.T. Sweet, 2003, Evidence of a deep source of bacterial methane in the Gulf of Mexico continental slope: American Chemical Society Meeting, New Orleans (Talk)

Roberts, H.H., J.L. Hunt, W.W. Shedd, and R. Sassen, 2002, Surficial gas hydrates, part of the fluid and gas expulsion response spectrum: Identification from 3D seismic data: 2002 Offshore Technology Conference, OTC 14033, 10 p.

Roberts, H.H., J.M. Coleman, J.L. Hunt, W.W. Shedd, R. Sassen, and A. Milkov, 2002, Gas hydrate deposits in a complex geologic setting northern Gulf of Mexico slope: Gulf Coast Association of Geological Societies Annual Convention, October 30 – November 1, Austin, TX., Official Program, p. 101 (Poster).

Roberts, H.H., 2002, Geologic and biologic responses to varying rates of fluid and gas expulsion – Northern Gulf of Mexico, American Association of Petroleum Geologists Hedberg Conference, Vanconver, April 7-10, 2002 (Talk).

Roberts, H.H., J.M. Coleman, J.L. Hunt, W.W. Shedd, A.V. Milkov, and R. Sassen, 2002, Fluid and gas expulsion on the continental slope, northern Gulf of Mexico: 2001 GCSSEPM Research Foundation, 21st Ann. Res. Conf.,

Petroleum Systems of Deep-Water Basin, (Poster).

Roberts, H.H., J.L. Hunt, W.W. Shedd, and R. Sassen, 2002, Surficial gas hydrates, part of the fluid and gas expulsion response spectrum: Identification from 3D-seismic: Proceedings Offshore Technology Conference, OTC 14033, May 6-9, 2002, p. 1-10, (Talk).

Roberts, H.H., J.M. Coleman, J.L. Hunt, W.W. Shedd, R. Sassen, and A. Milkov, 2002, Gas hydrate deposits in a complex geologic province (GOM): Linkage to fluid-gas expulsion: Gulf Coast Association of Geological Societies Annual Convention, Austin, TX, (Poster).

Sassen, R., A.V. Milkov, D.A. DeFreitas, and H.H. Roberts, 2002, Gas venting and gas hydrate stability in the northwestern Gulf of Mexico-significance to sediment deformation: Proceedings Offshore Technology Conference, OTC 14034, May 6-9, 2002, p 1-7, (Talk).

Roberts, H.H., J.M. Coleman, J.L. Hunt, W.W. Shedd, A.V. Milkov, and R. Sassen, 2001, Gas hydrates in a complex geologic province, Northern Gulf of Mexico: AAPG Annual Convention, Official Program, v. 10, p. A170, (Poster).

Roberts, H.H., 2001, A new source of energy from deep water – The potential of gas hydrates: Lafayette Geological Society, November 28, 2001 (Talk).

Roberts, H.H., 2001, Gas hydrates – Can they be produced from the Gulf of Mexico slope? Society of Independent Professional Earth Scientists (SIPES), April 17, 2001. (Invited Talk)

Roberts, H.H., J.M. Coleman, J.L. Hunt Jr., W.W. Shedd, A.V. Milkov, and R. Sassen, 2001, Gas hydrates in a complex geologic province, northern Gulf of Mexico: American Association of Petroleum Geologists Annual convention, Denver, Co., May 2-6, 2001. (Invited Poster).

Roberts, H.H., J.M. Coleman, J.L. Hunt, W.W. Shedd, A.V. Milkov, and R. Sassen, (Accepted), Gas hydrates in a complex geologic province, northern Gulf of Mexico: American Association of Petroleum Geologists

Convention, Denver, CO., June 3-6, 2001, Abst. (Poster).

Sassen, R., S.T. Sweet, A.V. Milkov, D.A. DeFreitas, and H.H. Roberts, Thermogenic gas venting and gas hydrate in the Gulf of Mexico potential significance to climate change: American Association of Petroleum Geologists Convention, Denver, CO., June 3-6, 2001, Abst. (Poster).

Sassen, R., S.T. Sweet, A.V. Milkov, D.A. DeFreitas, and H.H. Roberts, 2001, Thermogenic gas venting and gas hydrate in the Gulf of Mexico-potential significance to climate change: American Association of Petroleum Geologists Annual Convention, Denver, Co, May 2-6, 2001. (Poster).

Roberts, H.H., J. Coleman, J. Hunt Jr., and W. Shedd, 2000, Surface amplitude mapping of 3D-seismic data for improved interpretations of seafloor geology and biology from remotely sensed data: 50th Annual Gulf Coast Association of Geological Societies convention, October 25-27, 2000. (Talk).

Roberts, H.H., 2000, Fluid and gas expulsion on the northern Gulf of Mexico slope: American Association of Petroleum Geologists Annual Convention, April 16-19, New Orleans, LA., Program and Abstracts, p. A126. (Talk).

Roberts, H.H., Wm. J. Wiseman, Jr., J. Hooper, and G. Humphrey, 2000, Gas hydrate at or near the modern seafloor: Effects of water column temperature variations on hydrate stability: American Association of Petroleum Geologists Annual Convention, April 16-19, New Orleans, LA., Program and Abstracts, p. A126. (Talk).

Sassen, R., H.H. Roberts, and A.V. Milkov, 2000, Oil and gas fields, seafloor vents, seeps, and gas hydrate deposits as products of the Gulf of Mexico Petroleum System: 20th Annual GCSSEPM Research Conference, Deep Water Petroleum System, Houston, Texas, December 2-5, 2001, Abst. (Talk).

Roberts, H.H., R. Sassen, and A.V. Milkov, 2000, Seafloor expressions of fluid and gas expulsion from deep petroleum systems, continental slope of the northern Gulf of Mexico: 20th Annual GCSSEPM Research Conference, Deep Water

Petroleum Systems, Houston Texas, December 2-5, 2001.

Roberts, H.H., 2000, Fluid and gas expulsion on the northern Gulf of Mexico continental slope: Mud-prone to mineral-prone responses: American Geophysical Union, Fall Meeting, San Francisco, CA. Abst. (Talk).

Affiliated WWW Sites: Coastal Marine Institute

Revised date: March 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Central

Title: New Invasive Marine Species Colonizing Oil/Gas Platforms in the Northern Gulf of Mexico: Verification and Examination of Spread (GM-09-01-07)

Total Cost: $339,549

Period of Performance: FY 2010-2012

Conducting Organization: Louisiana State University Coastal Marine Institute

BOEMRE Contact: James Sinclair

Description:

Background: Invasive species have become a major problem in the marine environment for decades. They are transported around the world by various means, including on ship's hulls and in ballast water. The Gulf of Mexico has experienced several invasions from the Indo-Pacific, one of which is the ahermatypic/azooxanthellate coral Tubastraea coccinea, which, over the past 60-70 yrs. has colonized sites from the Florida Keys to Brazil. It has also colonized oil and gas platforms in the northern Gulf of Mexico and occurs there in high abundances – up to hundreds of thousands of colonies per platform. A new closely related congener has now been observed on a platform in the northern GOM – Tubastraea micranthus. A total of 81 platforms, both standing production platforms and Rigs-to-Reefs structures surveyed on the continental shelf of the northern Gulf of Mexico between 2000 and 2009 by SCUBA and ROV have confirmed that T. micranthus only occurred on one platform. The site occurs at the cross-roads of two major safety fairways/shipping lanes. The introduction appears to be recent. The presence of a second Tubastraea species in the Gulf of Mexico raises concerns about its ability to spread and possibly out-compete native species in their natural habitats.

Objectives: This study will analyze the character of the Tubastraea micranthus invasion in the northern Gulf of Mexico by measuring abundance, depth distribution, geographic distribution, growth rates, and reproductive viability.

Methods: We will determine the abundance of this new invasive species at its known platform location and other platforms within a 20-km radius of it, to determine whether

its populations have begun to spread through the region. Its depth distribution and depth limits will be determined using divers with still and video cameras and via ROV at depths > 37m. Tubastraea micranthus colony growth rates via asexual reproduction/budding and stolon production will be monitored. We will determine its reproductive viability in this new environment by examining reproductive state and planular development within the polyps.

Products: Final Synthesis Report, GIS, annotated bibliographic entries for relevant publications, and at least one peer-reviewed publication.

Importance to BOEMRE: The data gathered through this study will provide information to BOEMRE and other government agencies regarding whether this species needs to be controlled or eradicated, and on what time scale.

Current Status: Awarded. Several field cruises have accomplished ROV surveys. Diving work and related sampling has not been done due to restrictions on diving related to the Deepwater Horizon spill and possible oil contamination in the region.

Final Report Due:

April 2012

Publications: none

Affiliated WWW Sites: none

Revised date: May 2011

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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Planning Area: Western

Title: Long-Term Monitoring at the East and West Flower Garden Banks, Gulf of Mexico (2009-2013) (GM-09-02)

Total Cost: $375,600.00 **Period of Performance:** FY 2009-2014

Conducting Organization: NOAA Flower Garden Banks National Marine Sanctuary

BOEM Contact: James Sinclair

Description:

Background: The Flower Garden Banks (FGB) are two seafloor mounds approximately 110 miles southeast of Galveston, Texas. These are the largest topographic features on the continental shelf of the northern GOM, with thriving coral reefs covering over 350 acres.

This is a continuation of a series of previous monitoring efforts begun in 1988 to develop a long-term database related to the environmental health of the east and west FGB. Costs of the monitoring have been shared with the NOAA Flower Garden Banks National Marine Sanctuary (FGBNMS) since 1996; each agency currently provides one half of the funding (total above reflects only BOEM contributions). Oil and gas activity in the area has continually increased in recent years. This study is important to validate and to sustain our contention that BOEM lease stipulations provide effective mitigation of impacts to the offshore environment in general and to these sensitive and unique biological features. The East and West FGB have received an increasing variety of protective special area designations including the following:

National Marine Sanctuary (NOAA National Ocean Service) and is defined as a Marine Protected Area (MPA);

Coral Habitat Area of Particular Concern (HAPC) for Essential Fish Habitat (EFH) (NOAA Fisheries); and

Special Ocean Site (SOS) (Environmental Protection Agency).

Objectives: This effort will continue the long-term monitoring at the East and West FGB to detect any subtle, chronic effects from natural and man-induced activities that could potentially endanger community integrity.

Methods: This study will be conducted jointly by the BOEM and the FGBNMS through an Inter-Agency Agreement. The FGBNMS will conduct the work from their office using their dedicated research vessel. The monitoring will be consistent with past BOEM topographic features monitoring, as well as the previously required lease stipulation monitoring for activities located within the old 1-mile zone of the FGB (now a 4-mile

zone is in effect). Techniques are similar to most other coral reefs monitoring studies. Observations shall be made to evaluate coral community health. Continuously recording water quality instrumentation was added to the ongoing study in 2001. These instruments will be maintained and data analyzed for a variety of water quality parameters.
Study sites of 100m x 100m were established in 1988. There are two sites, one at the East Flower Garden Bank (EFGB) and one at the West Flower Garden Banks (WFGB). The following methods are used to measure community health on each of the banks.

1. Random Transects: sixteen transects of 10 m length are located in a stratified random manner with four transects randomly located in each quadrant of the study site. Sequential images are analyzed along the length of the transect.
2. Repetitive Quadrats: forty photographic stations are permanently located in each study site. In addition, nine deep stations are located adjacent to the EFGB study site in depths from 110 to 130 feet. Photographs cover eight square meters.
3. Lateral Growth Stations: sixty permanent stations are located in each study site for photography of lateral encrusting growth of the coral Diploria strigosa. Photos are compared with the previous year to measure the amount of lateral growth.
4. Accretion: sclerochronology is used to measure the thickness of accretion on the reef bi-annually. We take cylindrical cores of the coral *Montastraea faveolata*, cut thin slices, and x-ray them to highlight the layers of varying density. This allows measurement of vertical growth from one growing season to the next.
5. Video and Invertebrate transects: two belt transects of 2 m x 100m length are surveyed visually and with video at each study site. Visual surveys are done for sea urchins and lobsters. Video surveys are for characterization of the general health of the reef and for incidence of disease.
6. Twenty-four stationary fish surveys are performed to estimate community composition, density, and size.
7. Water Quality: data logging instruments are placed on each bank to record water quality parameters over time. Quarterly water samples are taken at three depths on each reef.
8. Qualitative observations of general health, disease, and change in the reef add to the assessment.

For a full description of past methods, see OCS Study MMS 2010-052.

Products: Quarterly reports, water quality data, data files, photos, videos, an interim report, and a final report

Importance to BOEM: The BOEM tracks the health of the (FGB) reef to detect natural changes in the ecosystem and identify any anthropogenic effects that could be caused by oil and gas activities. Ongoing monitoring at the FGB is important to validate and to sustain our contention that the lease stipulations provide effective mitigation of impacts to the offshore environment and particularly, these sensitive and unique biological features.

Current Status: Interagency Agreement in place. Field monitoring for 2009, 2010, and 2011 completed. Funding for refurbishment and mapping of site markers and sampling

stations requested.

Interim Report Due:	September 2012
Final Report Due:	June 2014
Publications:	none
Affiliated WWW Sites:	Flower Garden Banks Study Reports Flower Garden Banks Information Page
Revised date:	October 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Gulfwide

Title: Gulf SERPENT: Establishing a Deepwater Plankton Observation System Using Industrial ROVs (GM-92-42-133)

Total Cost: $351,939 **Period of Performance:** FY 2008-2013

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEMRE Contact: James Sinclair

Description:

Background: The pelagic waters seaward of the 200 m isobath remain a poorly studied region of the oceans in general and the Gulf of Mexico in particular. Oceanographic expeditions largely depend upon research vessels and the number of suitable ships in the UNOLS (University-National Oceanographic Laboratory System) fleet is limited. At best we are capable of gaining brief access to these regions for periods of a few days. Studying organisms in the water column or on the bottom frequently utilizes remotely operated vehicles (ROVs) or manned submersibles. The factor constraining access to these environments is primarily the cost of mounting research cruises to these areas and the general paucity of available manned and unmanned submersibles to investigate these deep regions of our oceans. Thus the principal obstacle to furthering biological oceanographic research in the deepwater regions is one of access to capable ships and ROV systems.

Deepwater drilling and production operations usually employ industrial ROV systems. These commercially-produced ROVs are sophisticated vehicles capable of operating to depths of over 1000 m while equipped with manipulator arms, cameras, lights and other sensors (e.g. temperature, pressure, current velocity). The number of industrial ROV systems in operation by the petroleum industry far eclipses the handful operated by the academic fleet. Moreover, these systems are located on semisubmersible rigs and drillships that remain in one location for months at a time. Unlike the oceanographic community, deepwater energy exploration provides the potential for extended access to poorly-studied regions of the ocean combined with appropriate ROV systems for deep sea exploration. Having appropriate ROV systems in place at locations of interest is of little scientific value if there is not time for them to conduct research. While the time budgets of industrial ROVs vary by site and stage of the drilling process, experience working with the operators of these systems suggests that on average, approximately 40 percent of the time, the ROVs are operational, but not otherwise tasked in support of drilling.

The concept of using some of the operational standby time of industrial ROVs for scientific research was the genesis of the SERPENT project (**S**cientific **E**nvironmental

ROV **P**artnership using **E**xisting I**n**dustrial **T**echnology)
(http://www.serpentproject.com/) based at the National Oceanographic Institute in Southampton, UK. SERPENT works to bring scientists and industrial partners together to explore the oceans with ROVs and other industrial technology. There are SERPENT Project partnerships in operation at almost all the major deepwater exploration and production centers around the world.

Objectives: The primary objective of this project is to establish a biological observatory network in the deepwater region of the northern Gulf of Mexico. This network will employ industrial Remotely Operated Vehicles (ROVs) to conduct regular video surveys of planktonic and nektonic organisms. Establishment of this network will provide a seasonal picture of the pelagic biodiversity in the deepwater region. The project will be linked with SERPENT* in-order to provide public outreach with Marine Advanced Technologies for Education (MATE) and LSU providing research experiences for undergraduate education. A secondary objective of the study is to document the settlement of hard and soft coral species and other epifauna on the deepwater platforms. This objective will be undertaken by adding ROV video examinations of the subsurface of the deepwater structures.

Methods: The total number of sites that are contributing data at any one time will likely fluctuate but a total of 10-15 locations are anticipated by the end of the first year. Several sampling methodologies have been developed:
Post-Riser Inspection Surveys - Surveys conducted when the ROV is available after work that has taken it to depth. An example of this would be after a riser inspection or inspection of the BOP. These surveys are designed to collect video of marine organisms between the bottom and surface. These surveys consist of a series of horizontal surveys at regular depths.
Dedicated Surveys - These are deployments of the ROV specifically to collect video data on organisms in the water-column. Such surveys can be conducted whenever the system is available but not otherwise tasked, and the ROV operators have time. During daytime, the best approach is to begin at 1000 feet and conduct horizontal transects at 500' intervals down to the bottom. At night they can begin at 100 feet and horizontal transects can be collected at 200' intervals down to about 1500 feet. At each depth interval, these surveys are the same as for the ascent surveys.
Opportunistic Surveys - Observation of marine life while conducting other work operations. For example: while conducting a riser inspection, you observe a jellyfish swimming near the riser. If time and operations permit, please record at least a minute of video of the organism including close-ups when practical. One easy way to accumulate these chance encounters is to label and keep a "Marine Life DVD" in the second burner and to record directly to the DVD whenever you encounter an animal during routine work operations. Information on the event can be annotated in the attached "Chance Encounter" video log. Opportunistic surveys have proved to be particularly fruitful in terms of discoveries of new organisms and range extensions of known taxa.
Documentation of Colonization by Deepwater Corals - The general approach will be to conduct regular (monthly) observations of fixed structures associated with the platform, for which a datum of establishment can be determined. These structures will be surveyed

with the ROV and any developing fouling organisms will be videotaped at close range. Such structures may include, but are not limited to, the subsea portions of the floating facility, anchor cables or tension legs, and bottom-mounted production equipment or the riser. Where feasible, settlement plates will be attached or suspended beneath selected facilities to document the recruitment of coralline species.
All video observations will be screened and separated into short clips, each containing a single species. These video data are archived to hard disks and DVDs. Still images from video clips are extracted. The date, time, location, and depth of the observation along with any other metadata such as water temperature are combined with a preliminary identification of the organism on to a standard data sheet used by the SERPENT Project. Detailed identifications result when the video clips are sent to individuals with particular taxonomic expertise on certain groups of organisms. Once organisms have been identified, representative video clips, stills and data are sent to the Serpent Project site for archiving and public dissemination. Once a sufficiently large number of observations of individual taxa can be accumulated, distributional patterns will be compiled based on depth, temperature, and geographic location. Using such an approach, this project will assemble a database of where and when planktonic organisms occur over a large region of the deepwater exploration and production zone in the Gulf of Mexico.

Products: Reports, imaging products, archived data sets, and peer-reviewed scientific publications.

Importance to BOEMRE: The BOEMRE will obtain information that will fill a large data gap for mid-water deep-sea animals in the Gulf of Mexico. This would be a good start in our understanding of mid-water biology of the deep Gulf. A recent EPA requirement for studies to assess the potential impacts of cooling water for power generation systems requires estimates of the relative abundances of organisms in the water column likely to be impacted by entrainment in cooling water intakes at offshore production and exploration facilities. This study will provide baseline data that could be used to assess such impacts. The resulting data will also be valuable for National Environmental Policy Act documents including lease sale Environmental Impact Statements. The stake holders of the Gulf of Mexico Region (the States of Texas and Louisiana, and the industry) will benefit through increased knowledge of a little known portion of the Gulf of Mexico, the deepwater pelagic region. Also, information regarding the colonization of deepwater surfaces by organisms including corals will provide significant information regarding the deepwater artificial reef effect. Many more structures will be decommissioned in coming years and significantly more in deepwater.

Current Status: Awarded. Three years of observations completed. Identification posters in preparation. A Gulf SERPENT highlights video was produced in 2009. We mourn the lives lost in the Deepwater Horizon disaster. The ROV of the Deepwater Horizon was one of the major contributors of imagery. The ROV crew was safely evacuated but their equipment, including the generously funded high resolution still camera are now all at the bottom of the Gulf of Mexico. A new 14 megapixel high resolution camera will soon be in operation on another ROV. In addition, other industry vehicles have largely been busy with other duties in the past year and are waiting to

resume normal operations

Interim Report Due:	September 2010
Final Report Due:	September 2013
Publications:	Benfield, M.C., J.H. Caruso, and K.J. Sulak. 2009. In situ observations of two manefishes (Perciformes: Caristiidae) in the mesopelagic zone of the northern Gulf of Mexico. Copeia 2009: 637-641. SERPENT Annual Report 2008 Curry, R. A., Jones, D. O. B., Gates, A. R., Benfield, M. and Thompson, M., June 2009. Benfield, M.C., B.A. Thompson, and J.H. Caruso. 2008. The second report of a sleeper shark (Somniosus (Somniosus) sp.) from the bathypelagic waters of the northern Gulf of Mexico. Bulletin of Marine Science 82(2):195-198. Benfield, M.C. 2007. SERPENT: industry and academia team-up to explore marine life in the Gulf of Mexico deepwater region. Marine Technology Reporter, September 2007, 50:7, 28-37. Gates, A.R., Jones, D.O.B., Benfield, M., Kaariainen, J.I. (2008) SERPENT Cruise Reports 2007. National Oceanography Centre, Southampton Cruise Reports Series No. 30. 158pp.
Affiliated WWW Sites:	BOEMRE website: SERPENT Spotlight International website: http://www.serpentproject.com/ Slide Show BBC video: Oar fish YouTube video: Oar fish BBC video: Mane fish
Revised date:	May 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: **E**co**S**patial **I**nformation **D**atabase – U.S. Atlantic Region (GM-08-x13)

Planning Area: North Atlantic, Mid-Atlantic, South Atlantic

Total Cost: $1,890,952 **Period of Performance:** FY 2009-2012

Conducting Organization: AMEC Earth & Environmental, Inc.

BOEMRE Contact: James Sinclair

Description:
Background: Most of the past Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) environmental work in the Atlantic region has been site specific and targeted rather than focused on broad geographic scales. With new offshore alternative energy activity and the possibility of new oil and gas activity, BOEMRE needs comprehensive information about the ecology of the U.S. Atlantic Region. Background material and geographic information system (GIS) based maps that overlay many types of information are needed for MMS to make critical decisions about Bureau-regulated activities, such as permitting and siting of development.

This project will collate existing sources of information to produce a database containing ecological and spatial information for portions of the BOEMRE Atlantic Region. This database will be the EcoSpatial Information Database (ESID, pronounced "ee-sid") and will be designed to accept additional ecological information for all marine and coastal areas of the U.S. The ESID will be accessible and searchable through a map interface.

The ESID will contain (and/or link to) ecological information resources and will include an annotated bibliographic entry for each resource, GIS files for each resource showing study areas or sampling sites, metadata for each resource, and any available associated GIS or data files. In addition, data will be extracted from resources addressing specific renewable energy areas of interest. Resources will be accessed via a map interface with search capability. The ESID will contain background GIS layers of bathymetry and other relevant information such as the shoreline, the EEZ, states, cities, marine protected areas, MMS protractions, latitude and longitude, etc. The potential types of information the ESID could provide includes access to PDF files of documents, annotated bibliographic entries, metadata, GIS files of resource footprints or sampling sites, data files

accompanying (or extracted from) a resource, and hyperlinks to resource information. Ecological information to be incorporated into the ESID include subjects such as benthic habitats, spatial and temporal distributions of species, commercially important species, and migratory pathways. Environmental data such as topography, sediment, salinity, temperatures, currents, and others will also be included.

The ESID database will provide the foundation for an ecosystem-based approach to management of the Atlantic Region. Ecology (by definition) deals with the interaction of living organisms with their environment. This encompasses both plants and animals as organisms and their relations to all aspects of the environment such as sediment, water quality, currents, irradiance, etc. It also includes the interaction of organisms with each other. All these components of ecology must be considered in ecosystem-based management of the Atlantic Region and will be incorporated into ESID.

Objectives: This project will create a searchable database with a map interface, the **E**co**S**patial **I**nformation **D**atabase, of georeferenced ecological information resources and associated data to support ecosystem-based management of activities permitted by BOEMRE in the Atlantic Region.

Methods:
Ecological information for a portion of the Atlantic Region will be compiled and assimilated using the following general methods.

1. Conduct thorough literature searches to collate ecological information resources for the areas of interest. Scan documents to PDF format as needed.
2. Document resource acquisition and copyright.
3. Create an annotated bibliography referencing every resource.
4. Create metadata for every resource.
5. Create GIS files defining the study area, sampling sites, or "footprint" for every resource.
6. Extract data from resources pertinent to renewable energy areas of interest
7. Design and create the ESID containing the following.
    a. Annotated bibliography.
    b. Metadata.
    c. GIS files of resource footprints.
    d. Background GIS layers: bathymetry and other relevant information such as the shoreline, the EEZ, states, cities, marine protected areas, BOEMRE protractions, latitude and longitude, etc.
    e. Information resources: documents, reports, articles, GIS files, data files, images, links to online resources, etc.
    f. Hyperlinks to resources (some resources will only be linked and will not reside in the ESID).
    g. Data extracted from resources pertinent to renewable energy areas of interest.
8. Create a map interface with search, reporting, and editing capability.
9. Write documentation and instructions.
10. Work closely with BOEMRE to produce a suitable system that works efficiently.

Products: **E**co**S**patial **I**nformation **D**atabase with annotated bibliography, database of ecological resources, ecological data files, GIS files, and ArcMap interface; list of data

files for the Multi-Purpose Marine Cadastre; peer-reviewed journal article; conference presentation; final report.

Importance to BOEMRE: With new offshore alternative energy activity and the possibility of new oil and gas activity, BOEMRE needs comprehensive information about the ecology of the U.S. Atlantic Region. This project will collect, organize, and provide access to needed information.

Current Status: Awarded September 24, 2009. Prototype ESID and ArcMap interface delivered March 24, 2010. Populated EISD database delivered March 2011. Currently in the process of contract modification to create a web-based map interface hosted in "the cloud", rather than the previously planned desktop application.

Final Report Due: March 2012

Publications: None

Affiliated WWW Sites: None

Revised date: May 2011

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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Deep-Water Reconnaissance of Potentially Sensitive Biological Features (PSBF's) Surrounding Shelf-Edge Topographic Banks in the Northern Gulf of Mexico (GM-11-01b)

Planning Area: Central and Western

Total Cost: $175,568 **Period of Performance:** FY 2011-2015

Conducting Organization: NOAA, Flower Garden Banks National Marine Sanctuary

BOEMRE Contact: James Sinclair

Description:

Background: The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) Notice To Lessees 2009-G39 describes protection for Potentially Sensitive Biological Features (PSBF's). These are seafloor features in the Gulf of Mexico (GOM) with moderate to high relief (about 8 feet or higher) that provide valuable habitat for benthic species and serve as Essential Fish Habitat. They are not covered by the biological stipulations on Leases. They provide surface area for the growth of sessile invertebrates and attract large numbers of fish. Habitat utilization of these features is expected to vary depending on physical parameters including relief, size, habitat complexity, association with other features (as in trends or systems of features), water quality, turbidity, depth, and temperature.

The BOEMRE has become aware of PSBF's from its large database of bathymetric surveys and from USGS multi-beam surveys. These features are protected from direct physical impacts of oil and gas activities based on bathymetry provided with permit applications. However, the benthic and fish communities of these features are relatively unknown. Of particular concern are multiple features known to exist in the vicinity of protected topographic features along the shelf-edge of the northern GOM. Available seafloor surveys suggest that these PSBF's support high diversity benthic communities similar to the lower levels of the protected banks. Significant areas of these features occur outside the bank No Activity Zones. The BOEMRE needs to investigate these PSBF's to characterize their benthic and fish communities and define their distribution. Bathymetric data alone does not describe the quality and sensitivity of this ecosystem. This information is required to ensure that the BOEMRE properly protects these valuable resources which are a significant component of the wider ecosystem.

The Deepwater Horizon oil spill on April 20, 2010, in block MC252, approximately 50 miles southeast of Venice, Louisiana, released millions of gallons of crude oil in the north-central GOM. The oil release was treated with dispersants both at the sea's surface and subsea (at about 5000 ft of water depth). The dispersed oil weathers, biodegrades, clumps, and eventually sinks to the seafloor. In this manner, the oil could be distributed

widely over a large area of the seafloor and could directly affect hard bottom communities.
This study is designed as an adaptive approach to management and may result in revision of BOEMRE No Activity Zone boundaries. The BOEMRE needs to characterize these features across the entire northern GOM. This study will begin that process by examining notable PSBF's known to exist near important topographic features along the shelf-edge. We will also assess the impact and recovery of these ecosystems to possible effects of oil from the Deepwater Horizon spill. Recent USGS work has provided high resolution multi-beam bathymetry around numerous shelf-edge topographic features in the northern GOM. In addition, the Flower Garden Banks National Marine Sanctuary (FGBNMS) has conducted several ROV surveys around a few of the banks. This study will be carried out in cooperation with the Louisiana Universities Marine Consortium (LUMCON), the FGBNMS, and the University of North Carolina Wilmington (UNCW).

Objectives: The objective of this study is to provide the BOEMRE with information needed to evaluate the quality and sensitivity of known PSBF habitats near protected topographic features, relate them to the wider ecosystem, and assess possible oil impacts/recovery.

Methods: This study will characterize both the physical and biological components of PSBF's near shelf-edge banks. The study will incorporate available information for these features and conduct field investigations to gather new information. In addition, sediment and tissue samples will be analyzed for effects from the Deepwater Horizon oil spill. The study will focus on representative areas of PSBF's around protected topographic features along the edge of the GOM continental shelf from the Flower Garden Banks to Jakkula Bank. Sampling sites will be selected to produce a representative description of features in this area. Work already done by the FGBNMS will be incorporated and supplemented to maximize our results. That work includes numerous ROV surveys at several shelf-edge banks. New information will be gathered with additional ROV surveys, water quality instrumentation, and sampling of benthic and fish components (including contaminants analyses). Semi-Permeable Membrane Devices may be deployed at each sampling site if continued deposition of oil is suspected. Other methods may be employed as available and appropriate, including SCUBA, AUV, submersibles, benthic samplers, and camera systems.

Products: Final Report, archive of still and video imagery, GIS files, data files, peer-reviewed scientific article.

Importance to BOEMRE: The BOEMRE needs to describe the character of Potentially Sensitive Biological Features (PSBF's) in the shelf-edge region of the northern Gulf of Mexico to establish baseline conditions, enhance identification of sensitive habitats, and ensure adequate protection. Potential impacts and recovery from the Deepwater Horizon spill should be assessed.

Current Status: Awarded

Final Report Due: July 2015

Publications:	none
Affiliated WWW Sites:	none
Revised date:	August 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Central and Western

Title: Deep-Water Coral Distribution and Abundance on Active Offshore Oil and Gas Platforms and Decommissioned "Rigs-to-Reefs" Platforms (GM-92-42-126)

Total Cost: $320,232 **Period of Performance:** FY 2006-2010

Conducting Organization: Coastal Marine Institute, Louisiana State University to Louisiana Universities Marine Research Consortium (LUMCON)

BOEMRE Contact: James Sinclair

Description:

Background: At present, there are approximately 3,600 oil and gas structures in the northern Gulf of Mexico (GOM), most of them occurring offshore from Louisiana and Texas . The shelf there is comprised almost entirely of soft sediment. The platforms provide hard substratum, extending up through shallow water, where no solid substrate exists or has existed for tens of thousands of years. They have provided new habitat for a wide variety of epibenthic fauna and flora, extending from the surface to a depth of hundreds of meters. Prior to the introduction of platforms, hard substratum was limited to scattered banks and shoals. Hard-bottom organisms were restricted to those banks. Platforms represent a novel development for the GOM and have provided thousands of artificial islands, affording suitable substratum for settlement of shallow-water marine organisms where, otherwise, none would be possible.

Early studies reported the growth of hermatypic (reef-building) scleractinian corals on the platforms in the GOM. This has been confirmed through more recent studies including the two preceding CMI projects and has been expanded to confirm the presence of both hermatypic (reef-building) and ahermatypic (non-reef-building) scleractinian corals on the platforms. Studies have demonstrated that oil and gas platforms within a 65 km radius of the Flower Garden Banks (FGB) not only possess limited thriving benthic communities, they also possess coral communities. Coral species diversity is moderately high there, (up to 11 species), with better developed communities being found on platforms $\geq$15 yrs old. The corals also had species-specific depth distributions.

More recent broad-scale surveys have demonstrated that both hermatypic and ahermatypic corals have colonized platforms not only around the FGB but also throughout the northern continental shelf in the western and central GOM, particularly near the shelf edge. The platforms are clearly facilitating "island-hopping" by coral larvae as a dispersal mechanism. The FGB are also apparently capable of self-seeding, increasing community stability on the banks. The FGB may also be serving as a source of larvae for colonization of the deeper portions of platforms and artificial reef systems.

Objectives: The specific objectives of this study include the following:

· Examine coral community development at >39 m depth using an ROV/AUV on select platforms in the northern GOM, and 33-39m using divers.
· Define comparative distributions and abundances there for hermatypic and ahermatypic corals.
· Determine genetic affinities between deep-water corals on platforms *vs.* shallower corals and those in artificial reef zones.
· Assess success of coral community development on toppled platforms within these zones.
· Assess any effects of aggressive invasive species which may thwart reef development.

Methods: Observations and collections will be performed by divers above 40 m of depth and using a remotely operated vehicle (ROV) equipped with lights and a manipulator to survey major portions of the jacket, including horizontal support structures from 40 m depth to the bottom. The study will target the Ship Shoal, West Cameron, and High Island areas, since this is where high densities of corals have been documented on platforms. It is also where a number of "Rigs-to-Reefs" Zones are located. The first aspect of the study will be to survey and quantify the adult coral communities on toppled platforms within the artificial reef zones and the deeper portions of platforms at the edge of the continental shelf in the northern Gulf. This will be done via direct diver surveys and ROV surveys, and will be performed from an independent charter vessel.

Products: Final report.

Importance to BOEMRE: Results will provide an assessment mechanism which will assist BOEMRE and other agencies in making informed decisions regarding the potential for well developed coral colonies existing on platforms prior to decommissioning. The study will also provide direct information on coral genetic connectedness between platforms (both standing and Rigs-to-Reefs) and the FGB. With the completion of this third dimension in understanding how corals colonize oil and gas platforms, BOEMRE will be well prepared to address questions relating to this significant animal group when needed in discussions regarding decommissioning, aquaculture etc.

Current Status: Field work began in May of 2007. Diving operations were performed on a total of three different standing platforms and one toppled Rigs-to Reefs structure. ROV operations were very successful using the SeaBotix LBV300S[6]. In addition to the previous standing platforms, two additional platforms too deep for diving were surveyed all the way to the bottom at 102 m and 84 m with the SeaBotix ROV. Additional field work took place in November of 2007. A final field sampling cruise was accomplished in May of 2008. All field sampling has been completed.

Final Report Due: June 2010

Publications: Sammarco, P.W., G.S. Boland, J. Sinclair, A. Lirette, and Y.H. Tung. 2008. Rigs-to-Reefs structures and coral community development in the northern Gulf of Mexico: a

first view. pp. 179-181. In: McKay, M. and J. Nides, eds. 2009. Proceedings: Twenty-fifth Gulf of Mexico information transfer meeting, January 2009. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-051. 298 pp.

Affiliated WWW Sites: Coastal Marine Institute

Revised date: May 2011

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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region:	Gulf of Mexico
Planning Area:	Gulfwide
Title:	MAG-PLAN Modification: Gulf of Mexico Data Collection, Streamlining, Testing and Repair of OCS Economic Impact Model (GM-08-08)
Total Cost: $476,825	**Period of Performance:** FY 2009-2012
Conducting Organization:	Eastern Research Group, Inc.
BOEM Contact:	Kristen Strellec

Description:

Background: BOEM maintains an OCS Economic Impact Model (EIM) called MAG-PLAN to provide a consistent bureau-wide approach to estimating employment, personal income, and similar economic impacts from OCS activities. MAG-PLAN is a Microsoft Access-based, 2-stage model that uses OCS-specific "cost functions" to estimate the industry expenditures required (by industry sector and onshore incidence of spending) to complete a given activity, such as drilling an exploration well or operating a production facility. The second stage uses general economic multipliers from the commercial economic modeling system IMPLAN to forecast employment, personal income, and other variables resulting from the initial industry expenditures.

Obtaining data at the appropriate level of detail for the different activity functions has proven to be difficult. Researchers developed many of these data largely in-house, with only limited documentation, and by using data supplied through BOEM studies. No publically or commercially available data source contains all of the data needed for the model. Also, the model exhibits software-related problems that make it unstable and easily corrupted. BOEM seeks professionals with expertise to update activity function data, to refine the methodology used to distribute industry expenditures onshore, to refine and test MAG-PLAN software, and to resolve the software issues that have been encountered running the model.

BOEM initiated two parallel efforts to help address these issues and provide information and technical support for this MAG-PLAN modification. First, a current ongoing study will provide useful information on offshore expenditure patterns for contracted services, and their allocation onshore by certain sectors. To prevent duplication of effort, this information will be shared with the MAG-PLAN Modification contractor as it becomes available. Second, BOEM has created a Modeling Review Board (MRB) to assist in the

technical oversight of this MAG-PLAN modification effort. The MRB consists of a group of consultants who will provide expert advice to BOEM regarding all aspects of this contract. The MRB will provide expertise in evaluating the review and testing of the actual model, suggest possible improvements and solutions to problems, and provide review and comments on all deliverables.

Objectives: The objective of the MAG-PLAN Modification study is to strengthen and refine the Bureau's procedures for estimating the onshore economic effects from OCS-related activities, by improving the current MAG-PLAN model.

Methods: This project will involve coordinating three linked but separate research efforts: (1) the identification and collection of industry expenditure data; (2) testing and streamlining MAG-PLAN functionality; and (3) documentation of all efforts. Specifically, the methods involved are as follows:

1. sensitivity analysis of expenditure data in the current model to determine the influence of various data on model outputs.
2. collection of industry expenditure data for various activity functions, which includes thorough investigation of all public and commercially available data sources, as well as any additional sources identified.
3. creation of new activity functions for FPSO systems; subsea tiebacks/well completions and seismic exploration.
4. Update sector allocation codes for onshore distribution of industry expenditures; and
5. Structuring model outputs to improve onshore distributions at the county/parish level. Streamlining the model would include, but not be limited to the following: simplify the current methodology for entering user-defined onshore impact areas; create a single screen that includes all the steps required to run the model; compress existing water depth categories; and revise the model so that E&D Scenarios are not forced to include drill depth categories, but retain the option to include them at the user's discretion.

Products: MAG-PLAN Economic Impact Model, User Manual and Comprehensive Report

Importance to BOEM: Modification of MAG-PLAN by improving data inputs as well as testing and streamlining the model, will substantially increase the accuracy of MAG-PLAN outputs and the efficiency of using it. This will aid broader BOEM efforts to understand the local and regional consequences of the program as industry activities expand or contract and will support planning, decision making and environmental assessments related to the management of mineral resources on the OCS.

Current Status: The contractor has provided all of the draft deliverables under the contract. BOEM staff has provided detailed comments on the draft comprehensive technical report to the contractor, and is currently finalizing comments on the draft user manual. BOEM staff is continuing their review of the draft model that was delivered.

Additional refinements needed to the underlying data and assumptions of the model, particularly to the onshore distribution of expenditures, have been identified and are ongoing. Portions of the reviewed deliverables are being circulated to an external model review board for external peer review.

Final Report Due:	March 2012
Publications:	N/A
Affiliated WWW Sites:	N/A
Revised date:	January 2012
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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Examination of the Relationship between Tourism and Offshore Oil and Gas Activities in the Gulf of Mexico (GM-11-06)

Planning Areas: Gulfwide

Total Cost: $296,294 **Period of Performance:** FY 2011-2013

Conducting Organization: Eastern Research Group, Inc.

BOEM Contact: Mark Jensen

Description:

Background: The potential effects of the OCS leasing program on recreation and tourism are major public concerns and are issues of particular importance to BOEM socioeconomic impact analysis. Since these industries are service-oriented and labor intensive, they generate many employment opportunities and financial opportunities for small business owners. Tourism has the added benefit of injecting money into local economies through visitor spending on locally produced services. Since the recreation/tourism industry and the offshore petroleum industry operate in the same coastal and near-coastal environments, their uses of these areas can conflict. Routine OCS actions raise concerns regarding issues such as industrial traffic, industrial releases, noise, marine debris, and aesthetics. The *Deepwater Horizon* (DWH) disaster has heightened concerns regarding the impacts of oil spills on tourism activity and has shown that a large spill can impact recreation and tourism through mechanisms other than those related to its impacts to the physical environment.

Objectives: The overall goal of this study is to support assessments of the potential effects of the OCS leasing program on recreation and tourism in the Gulf of Mexico region. The objectives of this study are:

- to update and extend the tools BOEM uses to estimate the scale of the tourism and recreation economies in the coastal zone of Gulf of Mexico and the potential impacts of OCS activities on them;
- to update and extend descriptions of the current Gulf Coast tourism and recreation industries in light of ongoing economic change, as well as in light of the DWH; and
- to examine aspects of the direct and indirect impacts of the DWH on tourism and recreation in order to better understand the potential impacts of possible future oil spills.

Methods: This study will examine the economic structure of the tourism and recreation economies of the Gulf of Mexico in light of the DWH oil spill and will attempt to better understand regional linkages between tourism and OCS activities. The study will have 3 parts.

Part 1 will attempt to quantify the economic scale of the tourism economy in each Gulf Coast County. This is a complicated task since many of the industries involved have both tourism and non-tourism related components. Part 1 of this study will use a statistical methodology that weights the levels of employment and wages in a particular industry by the extent to which that industry is tourism related. Part 1 will improve upon a previous BOEM study that addressed this issue.

Part 2 will synthesize available information regarding the nature of the recreation, tourism, and recreational fishing industries at the local/county level in coastal areas of the Gulf of Mexico. Part 2 will also entail a focused fieldwork effort to collect information on local/county level impacts of the DWH to these industries, on their longer term responses, and on their current trends and conditions. Part 2 will conclude with a final report that integrates the varied data sources from Parts 1 and 2 into an overall presentation of the nature of the tourism and recreational economies in the coastal areas of the Gulf of Mexico.

Part 3 will address one of the more fundamental issues raised by the DWH oil spill. Namely, there were a number of reports of the DHW spill affecting tourism activity along the Gulf Coast. However, one of the most notable features of these reports was that the effects of the DWH appear to have been determined by factors other than those related to physical damage to recreational resources in an affected region. The intent of Part 3 is to use a mathematical modeling approach, such as an econometric framework, to better understand the differential impacts of the DWH on tourism in different counties. However, there are a number of uncertainties regarding the feasibility and advisability of the statistical analysis BOEM currently envisions. Therefore, Part 3 of this study will only entail a preliminary examination of the feasibility of the proposed statistical analysis project. However, should the preliminary examination prove fruitful, BOEM may pursue the conduct of the comprehensive statistical analysis project at a later date.

Products: Part 1 of the study will result in a database and a final written report. Part 2 of the study will result in a literature archive and a final written report. Part 3 of this study will yield a memorandum that analyzes the feasibility of conducting a statistical analysis of the impacts to tourism from the Deepwater Horizon oil spill.

Importance to BOEM: There is a need for a fuller understanding of the structure of the tourism and recreation economies in the coastal areas along the Gulf of Mexico. There is also a need for a more complete picture of the effects of the DWH event on these economies. Both of these types of information will be relevant to future BOEM NEPA analyses.

Current Status: The kick-off meeting was held on October 4, 2011.

for this project are unique in relying on sub-bottom profiler data and sediment cores to locate, identify, and evaluate archaeological sites buried below the seafloor. Sites buried below the seafloor contain archaeological information critical to understanding prehistoric human migrations, contacts, and subsistence strategies for time periods and environments not represented in sites currently above sea level.

Products: Final Report of Findings

Importance to BOEM: The BOEM is responsible for managing the economic development of offshore natural resources in federal waters of the GOM. Pursuant to the National Historic Preservation Act, archaeological assessments must be conducted in advance of any ground disturbing activities to ensure that cultural resources are not adversely impacted by, or create hazards to industry development. The proposed research will expand upon the current knowledge base for prehistoric sites in the OCS, and assess if the current survey guidelines are sufficient for accurate interpretations of potential archaeological features. The study will also determine the most accurate and cost-effective methods for identifying archaeological deposits.

Current Status: This study was awarded in August 2007. A post-award meeting was held in October 2007. The first phase of Remote remote sensing operations were completed in July 2008. A total of 6 sites were surveyed. Coring operations were completed in July 2009. A total of 30 cores (totaling 136 sections) were extracted from four separate areas and were processed at LSU. Analysis is complete and a draft report is expected in February 2012.

Final Report Due: September 2012

Publications: Two professional conference papers have been presented on this study:

Evans, A., Oceanographic and Geomorphological Impacts to Potential Submerged Prehistoric Sites. Society for American Archaeology, Atlanta, GA, April 22-26, 2009.

Evans A., Oceanographic and Geomorphological Impacts to Potential Submerged Prehistoric Sites. Conference on Historical and Underwater Archaeology, Toronto, Ontario, January 6-10, 2009.

Affiliated WWW Sites: None

Revised date: December 2011

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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Forecasting Service Vessel and Helicopter Trips Related to OCS Development (GM-92-42-134)

Planning Area: Gulfwide

Total Cost: $344,053 **Period of Performance:** FY 2008-2012

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEM Contact: Sindey F. Chaky

Description:

Background: The oceans present a unique set of environmental conditions and adverse exposure which affects the methods, equipment, support, and procedures employed in offshore design, construction, and operational activity. Offshore activities often take place at substantial distances from shore and from other structures, at depths which require special equipment and procedures, and operations with rotating crews and a near continuous supply of materials. The offshore service industry provides transportation services to the oil and gas industry. These services involve moving personnel to, from, and between offshore installations and rigs; delivering drilling supplies, equipment, fuel, water, and food; towing rigs and placing and retrieving rig anchors; and supporting offshore construction projects.

A wide variety of marine vessels and helicopters comprise the offshore service industry, and the service market is characterized by its cyclic nature – dependent upon oil and gas prices and business cycles in the upstream sector – high levels of competition, fragmented markets, and highly leveraged businesses. Throughout the world wherever oil and gas is discovered, an offshore support industry will develop and evolve with the needs of industry and government regulation.

The demand for helicopter and support vessels in the GOM depends on the level of activity and amount of spending by oil and gas companies, where and how capital is allocated (e.g., shallow vs. deepwater, U.S. vs. world, exploration vs. production), and the differences in capital budgeting, if any, between independents and majors. The amount of spending cannot be controlled or predicted, since it depends upon the supply of, and demand for, oil and gas; market expectations regarding supply and demand; weather-related or other natural events; actions of oil producing countries to control prices or change production levels; general economic conditions; government regulation; and the price, availability, and development of alternative fuels.

Service vessel utilization rates tend to be seasonally dependent, with higher levels of utilization in the warm temperature months. Flight hours are also seasonal and are

influenced by and depend on the number of available daylight hours and occurrence of extreme weather events.

Boat owners charge a dayrate for the use of their vessel, while transportation contracts for helicopters and crewboats are typically awarded for a term or one year or longer. Anchor handling towing and supply (AHTS) vessels tend to command the highest dayrates in the GOM, followed by platform supply vessels (PSVs) and crewboats. Construction vessels command a premium similar to jackup units. AHTS vessels are closely correlated to drilling activity, and tend to have more volatile utilization rates than vessels such as crewboats.

Boats and helicopters are a commodity item and owners compete primarily on price, although safety, reliability, availability, and service are also important. Dayrates depend on factors such as the type and age of the boat, contract length (spot vs. long term), market conditions, and region of operation. When demand for services outstrips supply, rates increase first in the spot market and then when long-term rates are negotiated. Spot rates are more volatile than long-term contracts, and are also more sensitive to supply/demand imbalances.

Objectives:

- to expand and update the current BOEM descriptions related to service vessel and helicopter trips and to develop methodologies and usable equations to forecast the trips required to support a given level of oil and gas activity as represented by BOEM exploration and development (E&D) scenarios; and
- to describe more precisely the level of diversity and the magnitude of offshore activity in the GOM of the operational requirements associated with various activity classes.

Methods:

1. Provide a general description of the types of offshore service vessels employed in the Gulf of Mexico, review data sources available on the vessel fleet, outline the companies operating in the region, and discuss general market trends impacting the industry.
2. Categorize offshore activities and describe the general service and supply requirements for each category, including the factors that impact the number of service vessel trips and the uncertainty associated with quantification.
3. Develop a method to forecast the total number of service vessel and helicopter trips over a 40-year period using a set of relevant activity variables from the BOEM E&D scenarios broken out by planning area, and if feasible, stage of development, water depth, type of service vessel, or other relevant data categories.
4. Discuss the limitations of the model assumptions, and the possible implications they may have on the forecasts and methodologies.

5. Review operator plans from the BOEM on estimated service vessel and helicopter trips and compare with the model assumptions and methodologies.

Products: Forecast model and final report.

Importance to BOEM: Offshore service vessel and helicopter trips in the OCS are important components in the BOEM EIS since they directly impact port activity and comprise a significant portion of the offshore labor market. The BOEM requires a defensible method to forecast service vessel and helicopter trips for application in future EIS reports.

Current Status: A theoretical model was developed to quantify the spatial distribution of service vessel activity in the Gulf of Mexico, and all of the previously synthesized and collected data was applied in a spreadsheet-based model to baseline port activity by vessel type and stage of activity. Vessel data from Port Vision has been processed to understand the temporal and spatial variability of vessel counts and movements. A computational framework to correlate vessel tracks with offshore activity has been set up, and preliminary analysis is nearly complete. Preliminary work has been completed, additional funding obtained and additional Port Vision data has been requisitioned to enumerate all vessel activity over a longer period of time. This will help resolve gaps in vessel identification and improve the ability to extrapolate over long time horizons. A beta version of the model was presented to BOEM personnel and sensitivity analysis performed on the model parameters in a paper describing the model and user inputs. Some draft documents and data synthesis have been presented to BOEMRE. An extension has been requested to allow enough time for processing and analysis of the additional data, revisions to the model and compilation of the draft report for BOEM review.

Final Report Due: January 2012

Publications:

Mark J. Kaiser, "An Integrated Model Framework for Service Vessel Forecasting in the Gulf of Mexico," Energy – The International Journal, 35:2777-2795, 2010.

Mark J. Kaiser and Brian Snyder, "An Empirical Analysis of Offshore Service Vessel Requirements in the Gulf of Mexico," International Journal of Energy Sector Management, 4(2): 152-181, 2010.

Affiliated WWW Sites: None

Revised date: January 2012

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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Planning Area: Central and Western

Title: Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities: Reefs, Rigs and Wrecks (GM 08-03)

Total Cost: $4,388,421.00

Period of Performance: FY 2008-2012

Conducting Organization: TDI Brooks International Inc.

BOEM Contact: Gregory S. Boland

Description:

Background: It is well known that there are many locations with significant areas of hard bottom in the deep Gulf of Mexico (GOM), particularly associated with faulting above the tops of salt diapirs. These hard bottom areas are in virtually all cases, 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 amplitude anomaly geophysical maps used during the biological review process of potential impacts from proposed drilling operations or pipeline installations. Recent in-house analysis of industry 3D seismic seabed amplitude anomaly data has resulted in approximately 8,000 separate features that likely represent exposed carbonate hard bottom. An initial study has demonstrated the presence of numerous deepwater coral communities in the deep GOM but information is lacking for informed decisions regarding distribution and sensitivity to impacts.

The previous *Lophelia* deepwater coral study, *Characterization of Northern Gulf of Mexico Deepwater Hard Bottom Communities with Emphasis on* Lophelia *Coral* (Continental Shelf Associates, MMS 2007-044) was an important step in gaining knowledge of previously unknown sensitive biological features in the deep Gulf of Mexico. This study and final report is now available on the BOEM internet site linked above. Deepwater corals have become an increasingly significant habitat and area of study throughout the world with both intrinsic and socio-economic value.

Significant unanswered questions and new directions have become evident from the results of the initial study. Focused studies and process-oriented research are 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. These objectives are a

part of this new study awarded in July of 2008.

As an additional aspect of hard bottom habitat, this new study has been expanded to include artificial reefs created by both oil and gas structures in deepwater as well as shipwrecks. Initially, a separate study named *Deepwater Artificial Reef Effect (DARE) II* (a follow up to the WWII shipwreck study; MMS 2007-015) was scheduled for a single year's field work to look at older deepwater platforms. This study now merges the DARE II objectives with the *Lophelia* II study that was been deferred from 2007 procurement to 2008.

It is generally accepted that artificial reefs can serve a positive function by the creation of new hard bottom habitats in areas where hard bottom is naturally lacking (most of the GOM). In the case of fish, artificial reefs can act both as attraction devices and as new habitats where new fish biomass is created and exported, meaning production. The fouling community growing on new hard bottoms 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.

There are now numerous industry-related structures at water depths below 1,000 ft in the Gulf. 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 20 years and Cognac for 30 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.

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 BOEM 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 as a positive fisheries enhancement or other beneficial environmental function. The BOEM 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 GOM. The completed study "*Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: Artificial Reef Effect in Deepwater"* (MMS 2007-015) first approached this subject. This project looked specifically at older man-made structures represented by shipwrecks. Remarkable discoveries were made on some of the shipwrecks investigated during this project. One wreck was particularly significant, the *Gulfpenn* sunk in 1942, which provided a known recruitment time of 62 years. Numerous large colonies of *Lophelia* coral were discovered growing on the wreck

located at a depth of 1,820 ft.

Additional unexplored shipwreck sites were also added to this study as an additional stand-alone aspect. While some wreck sites have known extensive developments of deepwater coral, other unknown wreck sites determined from remote sensing will be visited for the first time. These other wrecks may have significant biological communities, but could also have national heritage importance. Their investigation has historically been difficult to accomplish as an independent project.

Objectives: The purpose of this 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). The use of artificial reefs of all kinds including platforms and shipwrecks (man-made hard bottom) will be utilized to enhance the understanding of variables controlling zoogeography. The additional objectives of this combined study will be to further explore the basic question, "Do man-made artificial structures function as artificial reefs in deep water?" Additional objectives also include the investigation of previously unexplored shipwrecks of the deep Gulf as well as returning to previously visited WWII wrecks to recover ongoing experiments and obtain additional images and samples for genetic analysis.

Methods: Similar to the previous *Lophelia* I study, this project requires the use of submergence facilities, in this case, a remotely operated vehicle (ROV) rather than a submersible. Some complimentary elements of this project will also be conducted by investigators from various USGS locations resulting in cost sharing benefits for many investigators and broader approaches to additional ecological disciplines. This project is sponsored by the National Oceanographic Partnership Program (NOPP) and partnering with the National Oceanic and Atmospheric Administration's Office of Ocean Exploration and Research (NOAA OER) for cost sharing of submergence and research vessel facilities used for most of the field sampling years.

Products: Written reports and maps detailing the distribution of observed deep-water hard bottom communities with special emphasis on coral communities, analyses of collected samples, synthesis of resulting data sets, and recommendations. Predictive methodologies will be proposed for evaluating the potential sensitive nature of hard bottom on the continental slope in other areas. Study results will include the evaluation of current mitigations and avoidance of chemosynthetic communities and consider typical avoidance of hard bottom areas appearing on 3D seismic surface anomaly geophysical maps.

Importance to BOEM: Sensitive biological features other than chemosynthetic communities in deep water are just beginning to be addressed by BOEM. There is still little known about the complexity and distribution of hard bottom communities in the deep Gulf that are not directly related to chemosynthetic communities.

Current Status: Field work for the project began 5 September 2008 with the first leg on the NOAA ship *Nancy Foster* leaving Galveston Texas. This leg was primarily dedicated

to the exploration of unknown shipwreck sites. The first unknown site visited turned out to be a remarkable discovery of a copper-clad sailing schooner likely dating to the early 1800's. The hull of the ship was exposed above the bottom as well as its intact copper sheathing. Another wreck site visited was confirmed to be the *Gulfoil*, a tanker that was sunk by a German U-boat during World War II in 1942. Similar to the *Gulfpenn*, another tanker sunk during WWII not far away and sunk just thee days earlier; it was also covered with dense thickets of the deepwater coral *Lophelia*. This cruise leg had to take shelter in Pensacola due to Hurricane Ike but returned offshore for some additional work until two days before the second leg began on September 20. Luckily, the scheduled port of return was Gulfport Mississippi rather than Galveston. The second leg is dedicated to exploration and sampling of both known deepwater coral habitats as well as new unexplored hard bottom sites. This leg has had good success including the observation of a very large black coral tree at one site estimated to be at least 500 years old and over 5 feet tall at a depth of about 980 feet.

Separately funded collaborative cruises with the U.S. Geological Survey immediately followed the return of the second leg of the BOEM/USGS project. USGS did a variety companion studies including the use of benthic landers and trawls using the same NOAA research vessel *Nancy Foster* at several of the same sites as well as a visit to a deep coral site in the eastern Gulf. This interagency collaboration will greatly enhance the overall success of both projects through sample and data exchange.

The second year of field work took place during two different cruises. The first cruise utilized the unique autonomous underwater vehicle (AUV) Sentry operated by the Woods Hole Oceanographic Institution. This cruise was dedicated to reconnaissance of a variety of stations, both natural hard bottom and archeology sites in order to focus future efforts using more expensive ships and ROVs. This cruise between 17 June and 1 July was also very successful. The *Sentry* AUV accomplished numerous remote sensing surveys as well as photo mosaics. One shipwreck was especially notable at a depth of over 7,000 feet, the deepest wreck site known in the Gulf of Mexico. The next cruise between 19 August and 12 September utilized the NOAA ship *Ron Brown* and the world-class ROV *Jason II*also from Woods Hole (both facilities provided by NOAA OER). The cruise mobilized in Key West Florida and also included stations located in the eastern Gulf and along the steep Florida Escarpment. During this 25-day cruise, a total of ten new sites were explored during twenty-one *Jason* dives looking for the occurrence of deepwater coral as well as to make collections for a variety of studies including genetic analyses and coral experiments in the laboratory. The NOAA Ocean Explorer web site listed below contains extensive details and imagery from this cruise.

An interim project planning meeting was held in Shepherdstown West Virginia February 17 and 18, 2010 to evaluate the status of the project thus far as well as plan for the final field sampling work later in 2010. Collaborating scientists from the U.S. Geological Survey also presented their results and plans for the completion of their project components. One additional cruise is planned for October 2010, also using the NOAA ship *Ron Brown* and the ROV *Jason II. Additional* work on deepwater platforms is also in the planning stages.

A third year of field work and the fourth cruise took place between October 14 and November 4 2010, again utilizing the exceptionally qualified NOAA research vessel *Ron Brown* and the Woods Hole ROV *Jason II* and again provided by NOAA Ocean Exploration and Research. A cruise report has not yet been completed, but the cruise was very successful. Although the project began long before the Deepwater Horizon oil spill, it has taken on a great deal of significance since that spill. Many of the stations investigated in this study were located within 20-30 miles of the Macando well in block MC 252. These provided exceptional baseline stations to revisit and look for impacts to deep coral habitats that were located directly below the oil on the surface of the gulf of Mexico for months.

A new site was chosen in close proximity (7 miles SW) to the Macando well to investigate potential impacts to hard bottom communities related to the accident. On the last day of the cruise, this site was visited using the *Jason II* ROV and a number of gorgonian corals were observed with dead or dying tissue. Final analysis results from samples of tissue and sediment are not yet available but will be published in a scientific journal as soon as possible. Details of the entire cruise and this final day of sampling are described on the NOAA Ocean Explorer site listed in the web sites below.

There is a continued possibility of extending the field sampling portion of this study into an additional year, 2012. Budget availability is in place from both NOAA OER and BOEM for field sampling of corals deepwater platforms. This aspect was one of the study components that was not logistically possible to accomplish using the NOAA vessels in 2009 and 2010.

Final deliverables will include a 20 minute educational video based in Google Oceans. A number of video clips from the project can also currently be viewed on YouTube by searching the term 'Lophelia II."

Final Report Due:	July 2012 (may be delayed if extra cruise occurs)
Publications:	Wolff, Susan . 2008. Investigating Deepwater Reefs, Rigs and Wrecks – Biodiversity Hotspots. Ocean News and Technology, 15(5):38-39
Affiliated WWW Sites:	http://oceanexplorer.noaa.gov/explorations/08lophelia/welcome.html http://oceanexplorer.noaa.gov/explorations/09lophelia/welcome.html http://oceanexplorer.noaa.gov/explorations/10lophelia/welcome.html Link to companion Lophelia II-related deepwater coral studies conducted by USGS: http://fl.biology.usgs.gov/DISCOVRE/index.html
Revised date:	December 2011

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BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Subsistence In Coastal Louisiana: An exploratory study (GM-09-01-09)

Planning Areas: Central

Total Cost: $140,309 **Period of Performance:** FY 2011-2013

Conducting Organization: LSU Department of Geography and Anthropology

BOEM Contact: Dr. Harry Luton

Description:

Background: Wild foods-most notably, shrimp, fish and oysters-are unusually important people's diets in coastal Louisiana. Much of this is purchased. However, many coastal Louisiana households harvest much of the wild foods that they consume and many of these households distribute and receive these wild foods in ways other than by buying and selling. These facts are widely known but are poorly documented. Everyone knows that coastal Louisiana households consume large quantities of shrimp, fish and oysters, but no one is clear about how much is typically consumed, or how much a household typically harvests for its own consumption and how much it gets from elsewhere, or how much is purchased and how much comes from other sources.

In coastal Louisiana and other places with relatively low incomes, access to wild resources provides high quality foods that would otherwise be unavailable. For some households, such resources are an indispensible part of the family budget, a substitute for adequate income. Subsistence foods are also preferred foods and their contribution to the overall quality of life of coastal residents is great although, again, not well documented or understood.

The importance these foods to coastal Louisiana and the lack of information concerning their acquisition and use were underscored by the *Deepwater Horizon* oil spill (DWH). For example, people claimed damages for the loss of wild foods due to impacts on their ability to harvest for their own domestic use. Claims were also made due to the loss of wild foods normally received from others. The spill also raised concerns about seafood contaminant levels deemed "safe" by the EPA since consumption levels of seafood in coastal Louisiana are substantially higher than the "normal" amounts upon which EPA determinations are based.

Objectives: This study has four objectives:

- explore the full range of subsistence activities related to production, exchange and use of wild resources, including such activities as sharing, gift exchange, barter, and small-scale informal sales from the harvest;

- identify key dynamics in the overlapping activities of commercial harvesting, household consumption, gift exchange, barter, and small-scale informal sales from the harvest;
- field test and develop research methods that can produce valid, reliable, and quantifiable data on subsistence in coastal Louisiana; and
- produce preliminary data about subsistence harvesting, exchange, and consumption.

Methods: To accomplish the study goals, the research team will conduct an extensive literature review and synthesis of published works, grey literature and government reports to refine the study area and methods and to provide documentation of coastal subsistence uses. The team will collect and synthesize formal expertise on Gulf subsistence from such sources as city, parish and state officials (including, for example, field and area officials with the Louisiana Department of Wildlife and Fisheries, and the local sheriffs' offices who enforce limits on wild harvesting), regional ethnographers working on National Park Service-funded projects, and researchers in other fields whose work touches on wild harvesting, including biologists working at Sea Grant, LUMCON and at Nicholls State University. This synthesis will be used to more clearly define the characteristics of Gulf subsistence and to refining research questions. The team will collect subsistence information from coastal residents using a community partnership approach. As part of this approach it will use such methods as focus groups and participant observation as well as more formal ones such as collecting food diaries, freezer and pantry inventories, and hunting/fishing journals. Organized community outreach will involve a wide sector of the many communities of Terrebonne and Lafourche Parishes

Products: Informational flyer; database and maps; annotated bibliography; transcribed discussions; interim and final study reports

Importance to BOEM: The information and analyses provided by this research will support BOEM assessment and decisionmaking. The collection of information on subsistence behavior in coastal Louisiana is highly relevant to the agency's mission, particularly in the aftermath of the DWH. The commercial and domestic use of wild resources is a significant aspect of the area's economy and social system, and the interaction between subsistence activities and the petroleum industry's use of this environment has long been seen as unique and mostly positive. Very little is known about the subsistence portion of wild resource use on the Gulf Coast and documenting it will substantially improve BOEM's baseline descriptions and analyses. The aftermath of the DWH accident has underscored the importance of subsistence to BOEM assessments of socioeconomic impacts and of environmental justice.

Current Status: Study startup occurred as scheduled. All research components-literature review, synthesis of expertise, and fieldwork are underway. Because of the exploratory nature of this research, plans include multiple meetings are planned the study and BOEM staff members to resolve technical questions. Two such meetings have occurred. Although establishing community partners has been slower than anticipated, this has not affected overall study progress. The study is progressing as planned. The

final report is expected June 30, 2013.

Final Report Due:	July 2013
Publications:	None
Affiliated WWW Sites:	None
Revised date:	December 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Ethnic Groups and Enclaves Affected by OCS (GM-08-05)

Planning Areas: Gulfwide

Total Cost: $751,500 **Period of Performance:** FY 2011-2013

Conducting Organization: LSU Department of Sociology

BOEMRE Contact: Dr. Harry Luton

Description:

Background: United States society is notable for being largely defined by numerous and varied ethnic groups. Louisiana, Texas, Mississippi, Alabama, and Florida, states in which BOEMRE assesses the onshore effects of offshore petroleum development are not exceptions. Coastal areas of the Gulf of Mexico (GOM) have been long known for their ethnic enclaves; products of unique environments and history. Many of these groups have been affected by the rise of the offshore oil industry. Louisiana's Cajuns, for example have to some degree been self-defined by participation in the petroleum industry, while a smaller Alabama ethic enclave also called "Cajuns" found work in the refining industry. More recent history has led to the creation of additional ethnic enclaves linked to the oil industry in one way or another. Vietnamese and Laotians have interacted with the industry as commercial fishermen but also as workers in the shipbuilding and fabrication workforce. More recently this role has also been assumed by Mexican immigrants.

Objectives: The research objectives are to:

- collect and synthesize information on the origin and distribution of ethnic groups, communities and enclaves, and on the historical processes affecting their distribution and conditions;
- identify the current socioeconomic conditions for selected ethnic groups and to highlight any significant direct and indirect effects that offshore petroleum-related activities have had or are having on these groups, communities, and enclaves; and
- report study results in formats that facilitate its use by BOEMRE analysts and decision makers, other governmental institutions, and the interested public and to facilitate future synthesis efforts by BOEMRE and others.

Methods: Available literature and census data on the origin and distribution of ethnic groups, communities and enclaves, and on the historical processes affecting their distribution and conditions will be collected and synthesized. Data collected from prior studies, in concert with some demographic data on the size of ethnic populations that can be readily compiled from US census data (particularly that collected following the 2005 hurricanes) will be used to identify potentially affected communities with significant ethnic populations. To guide the immediate selection of the case study communities,

field researchers will compile and review field notes and newspaper articles from three prior studies: *Offshore Oil and Gas History Project, the Impacts of the Offshore Oil and Gas Industry on Gulf Coast Communities, and the Fabrication and Shipbuilding Study*. The classifications of ethnic communities (e.g., Vietnamese, Houma Indian, and Puerto Rican) used by interviewees in the previous studies will be utilized in the process of identifying the communities, locating them on a map of the GOM, and synthesizing in an excel database information about their members' occupations and connections to the offshore oil and gas industry.

The research team will identify the current socioeconomic conditions for selected ethnic groups and to highlight any significant direct and indirect effects that offshore petroleum related activities have had or are having on these groups, communities, and enclaves. The key tasks include the completion of qualitative case studies and socioeconomic profiles for selected ethnic groups in the study area. Fieldwork for the qualitative case studies will begin within three months of the project start and will include discussions with representatives of groups who are in touch with and gathering information on their members, and an initial analysis of how livelihood strategies, ethnicity, and the Deepwater Horizon accident and spill interact to differentially impact individuals and communities along the GOM. The researchers will work closely with community leaders to identify the data that exist and are being generated locally and gain local insights into the scope and nature of the impacts of both the Deepwater Horizon release and the offshore oil and gas industry in general.

Products: A comprehensive report, annotated bibliography, and databases.

Importance to BOEMRE: The information and analyses provided by this research will support BOEMRE assessment and decisionmaking. First, Executive Order 12898 and laws addressing Native Americans direct agencies to consider specifically the possible adverse effects of their decision making and proposed actions on minority and low income groups. Study results will support agency environmental justice assessments as directed by EO 12898, other laws and orders, and CEQ guidelines. Second, under NEPA environmental assessments consider the distribution of benefits and burdens among groups affected by agency decisionmaking. Study results will be sufficiently broad to support these more inclusive questions concerning who has been affected and who has not and what have been the benefits as well as the burdens.

Current Status: Study startup was delayed by Deepwater Horizon oil spill. The study plan was revised to increase its fieldwork component and to begin this it work immediately. Additional funds were added to support these changes. The three components of the research - demographic analysis, literature synthesis, and fieldwork are now underway.

Final Report Due: July 2013

Publications: None

Affiliated WWW Sites:	None
Revised date:	May 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Environmental Justice: A Comparative Perspective in Louisiana (GM-92-42-106)

Planning Area: Central

Total Cost: $46,300 **Period of Performance:** FY 2003 - 2006

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEMRE Contact: Dr. Harry Luton

Description:

Background: The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), like all other Federal agencies, must identify any disproportionate impacts of its activities on minority or low-income populations. Similar to Environmental Impact Statements that seek to identify adverse environmental impacts, Federal agencies must, in response to Executive Order 12898 (59 FR 7629), gauge the potential impacts of Outer Continental Shelf (OCS) exploration, extraction, and transport activities on vulnerable populations.

Objectives: This project seeks to employ a geographic perspective to compare the relative degree of environmental justice impacts found in different sectors of the oil extraction and processing industry. In particular, it will build upon the methods developed in previous BOEMRE (formerly MMS) research in this area to investigate environmental justice concerns associated with OCS oil and gas extraction.

Methods: This study will use identical GIS-based techniques developed in an analysis of Lafourche Parish for Jefferson and St. Barnard parish. The study will map zones of vulnerability (e.g., areas with low-income or minority populations proximate to existing environmental and human health impacts; areas of overlap between natural resource use areas and potential environmental impacts) using maps of local populations, oil production and refining activities, and local natural resource use.

Products: Annotated bibliography, final report, maps.

Importance to BOEMRE: This project has refined and applied a methodology that the GOMR has used in an earlier Environmental Justice analyses.

Current Status: This is a field test of an earlier research effort funded by BOEMRE (formerly MMS). The final study report was delivered to BOEMRE weeks before hurricane Katrina. This study is in the process of being closed; final technical edits will be completed in-house.

Final Report Due: December 2005

Publications:	None
Affiliated WWW Sites:	Coastal Marine Institute
Revised date:	April 2011
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Central and Western

Title: Archaeological Analysis of Submerged Sites on the Gulf of Mexico Outer Continental Shelf (GM-09-04)

Total Cost: $280,916 **Period of Performance:** FY 2010-2011

Conducting Organization: Tesla Offshore, LLC

BOEMRE Contact: Dr. Christopher E. Horrell

Description:

Background: The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) is charged with the responsibility of considering the effects of its actions on significant cultural resources on the Outer Continental Shelf of the United States, from State Waters to the limit of the Exclusive Economic Zone. This program arose out of a variety of legislation enacted to ensure proper management and protection of the nation's cultural heritage. The most pertinent of these laws are the National Historic Preservation Act (NHPA) of 1966 (as amended), the National Environmental Policy Act (NEPA) of 1969, and the Outer Continental Shelf Lands Act (OCSLA) of 1978. In order to meet this responsibility, the BOEMRE requires the oil and gas industry to conduct high-resolution remote sensing surveys in advance of any bottom-disturbing activities such as exploration drilling or pipeline construction and to submit an archaeological report analyzing these data.

While BOEMRE has complied with Section 106 of the NHPA by requiring industry to conduct remote sensing surveys and avoid targets that may represent significant archaeological resources, minimal testing has been performed to ascertain the effectiveness of this mitigation strategy. Ground-truthing targets that have been recommended for avoidance provides the BOEMRE an opportunity to both evaluate the actual archaeological significance of the targets and to assess industry compliance with the BOEMRE-stipulated avoidance criteria. An initial MMS study, completed in June 2006 (Enright, et al., 2006), 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 MMS study has developed a formula for determining appropriate avoidance distances for historic 20th century shipwrecks in deepwater (Church, et al., 2007), no such formula has been attempted for historic shipwrecks along the shelf. The knowledge gained from this study will allow the BOEMRE to implement

management practices that can more accurately identify how significant archaeological resources appear in the remote sensing record. This adaptive approach will assist in determining a more practical avoidance radius for these resources.

Objectives: The objectives of this study are to ground-truth, positively identify, and assess the potential National Register significance of at least six probable shipwreck sites by conducting a Phase II investigation of each of the targets and associated debris fields as defined in National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation (1991) available online at http://www.cr.nps.gov/NR/publications/bulletins/nrb15/. Analysis of site formation processes at each site should be conducted to provide recommendations of potential avoidance criteria for shallow-water shipwreck sites. Services required for this study will include, but not be limited to, archival and historical research; archaeological and geomorphological remote sensing surveys (marine magnetometer and sidescan sonar, at a minimum); and diver site testing/evaluation.

Methods: The objectives of the study will be achieved by groundtruthing targets selected by BOEMRE archaeologists from among the sidescan sonar targets already supplied by industry that are suggestive of shipwrecks (currently, there are over 1,200 targets in the BOEMRE database). The criteria for selection will include the evaluation of an acoustic image, the association of magnetic anomalies, and the report of an historic shipwreck in the target vicinity. Testing will be performed by marine archaeologists applying a variety of techniques including remote sensing, diving, and underwater imagery. The project will likely consist of extensive photographic documentation and limited excavation and artifact collection for identification purposes, as well as historical research.

Products: Products may include, but are not limited to, archival and historical documentation, special studies, technical reports, site survey forms, "standard National Register forms" in accordance with 36 CFR Part 60, and other forms as may be required under applicable laws, regulations, and guidelines.

Importance to BOEMRE: This study will fulfill BOEMRE's responsibilities and requirements under current archaeological resource protection laws. It will also allow BOEMRE archaeologists to ascertain the effectiveness of current mitigation requirements to determine if the remote sensing targets that are selected have any archaeological significance.

Current Status: This study was awarded in September 2009 and a post-award meeting was held in November 2009. Six probable shipwreck targets have been selected, three of which may be U-boat casualties from World War II. The WWII vessels have been tentatively identified as *City Services Toledo, R.W. Gallagher*, and *Heredia*. Background research has begun on reported shipwrecks in the vicinity of selected targets, with specific emphasis on the three possible WWII shipwrecks. Geophysical surveys are scheduled to be completed within in the next three months.

Final Report Due: September 2011 (Interim)
April 2015 (Final)

Publications:

Affiliated WWW Sites:	Enright, et al., 2006: http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3595.pdf Church, et al., 2007: http://www.gomr.mms.gov/PI/PDFImages/ESPIS/4/4239.pdf
Revised date:	October 2010
ESPIS	**ESPIS** - All ***completed*** ESP Studies: **Full Text, Online, Right Now!** **E**nvironmental **S**tudies **P**rogram **I**nformation **S**ystem

ACCESS NUMBER: 13010

STUDY TITLE: Impacts of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf

REPORT TITLE: Impacts of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf

CONTRACT NUMBER: M07PC13010

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREAS: Western and Central

FISCAL YEARS OF PROJECT FUNDING: 2007, 2008, 2009, 2010

COMPLETION DATE OF REPORT: June 2011

COSTS: FY 2007: $89,652.64; FY 2008: $165,331.56; FY 2009: $7,784.37; FY 2010: $17,333.10

PROJECT MANAGER: Robert L. Gearhart

AFFILIATION: PBS&J

ADDRESS: 6504 Bridge Point Parkway, Suite 200, Austin, Texas 78730

PRINCIPAL INVESTIGATOR: Robert L. Gearhart

KEY WORDS: Gulf of Mexico; archeology; oceanography; *Castine; Gulf Tide, New York*; Site 323; particle size; remote-sensing; hurricane; wave modeling; sedimentology; box core; artifact; artificial reef; marine sediments; shipwrecks

Background: Within a four week period in the second half of 2005, the Gulf of Mexico (GOM) was significantly impacted by two major hurricanes, Katrina and Rita. The massive forces associated with these storms left a wide path of destruction and devastation not only in the coastal areas where they made landfall, but also on and beneath the waters of the GOM. The magnitude of this damage raised questions within the archeological arm of the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) regarding the potential environmental effects to shipwrecks lying on or embedded in the seabed when storms of such magnitude pass overhead. In response to the destructive forces of these two Category 5 hurricanes, BOEMRE allocated over $1.5 million through their Environmental Studies Program to conduct research on the impacts of these storms on natural and cultural resources. In January 2007, BOEMRE contracted PBS&J of Austin, Texas to assess the impacts of recent hurricane activity on selected historic shipwrecks in the GOM.

Objectives**:** (1) to conduct remote sensing surveys in order to document the macro-scale post-storm condition of the sites; (2) to compare and contrast pre- and post-storm remote-sensing data from each site; (3) to carry out diver investigations of selected sites to document areas which had changed during the period between pre- and post-storm surveys; (4) to collect sedimentary

samples in order to characterize the substrate; (5) to estimate peak storm conditions on the seafloor at each site based on wave-current interaction models; and (6) to conduct archival and historical research of the primary study sites to fill gaps in their histories.

Description: Ten wrecks were selected for investigation based on their proximity to the hurricane paths and on the availability of pre-storm archeological data. Each wreck was subjected to a magnetometer and side-scan sonar survey at 30 m transects during a remote-sensing cruise from May 8-11, 2007. The remote-sensing data were analyzed and compared to pre-storm sonar data in order to identify potential hurricane impacts. As a result, four of the wrecks were selected for further investigation during the dive cruise from October 1-10, 2007. Divers recorded visual observations, measurements, underwater photographs (when possible), DIDSON acoustic camera imagery, in the case of *New York*, a complete site map. Box cores of the localized sediment were collected in a diver-operated stainless steel collection device, separated into levels based on stratigraphy, and analyzed for particle size in the lab. The samples were measured for textural percentages using the hydrometer method.

Wave-current interaction models were run at each of the four primary study sites in order to qualitatively assess whether hydrodynamics induced by Hurricanes Katrina and Rita could have caused damage to study shipwrecks. Model input data relied on hindcast environmental conditions during each hurricane, and the physical parameters of each wreck. The resulting wave model used stream function wave theory, was fully nonlinear, and was mathematically valid in deep water.

An archival research trip was conducted from January 21 – February 1, 2008. Repositories visited include the Mariners' Museum in Newport News, Virginia, the Library of Congress, and the National Archives branches in Washington, D.C. and College Park, Maryland. Additional research was conducted through phone and email correspondence with The Smithsonian Museum of American History, the Naval Historical Center, the U.S. Coast Guard Historian's Office, Lloyd's of London, and the Special Collections of the New York Public Library. Several newspaper archives were also searched for any published accounts of the various vessels' wrecking events.

Two archeologists conducted a research trip to New Iberia, Louisiana, from December 1-5, 2008. Over 500 items were documented from the artifact assemblage of *New York*, which has been recovered during periodic site excavations by the salvage group *Gentlemen of Fortune.*

Significant Conclusions: The damage caused by hurricanes Katrina and Rita to the primary study wrecks was substantially less than anticipated based on the level of damage reported for artificial reef vessels in waters offshore of Florida. Exploring the reasons for this observation has led to formulation of a hypothesis that the level of damage to a shipwreck (or artificial reef vessel) is relatively high after the first one or two hurricane passages, and is progressively less following later storms. The preservation of articulated wooden hull and an *in situ* artifact assemblage on *New York* has demonstrated the potential for burial to provide a high degree of protection from hurricane damage to many more historic wood-hulled vessels in the GOM. Finally, studies of storm damage to petroleum infrastructure demonstrate that hurricanes have the potential to cause indirect damage to shipwrecks that is anthropogenic in nature. This conclusion

has potential implications for the regulation of petroleum industry activities and the management of submerged cultural resources in the GOM.

STUDY RESULTS: Six of the ten wrecks surveyed exhibited no discernible impacts from hurricane activity. Damage at *Castine* was inconclusive, though there was evidence that storm currents swept loose artifacts and debris off of the deck and onto the surrounding seafloor. Site 323 was more severely impacted by hurricane forces; a 20 ft-x-30 ft rupture was opened in the lower hull near the stern, and the starboard rudder had been removed. The hull breakage was exacerbated by the Beaumont Formation of Pleistocene sediments lying directly underneath the wreck. *Gulf Tide* also exhibited increased amounts of sediment burial compared to pre-storm sonar data; however, determination of any additional impacts was inconclusive. The vessel is broken into two sections and appears to have been salvaged shortly after its sinking. *New York* received no negative impacts from Hurricane Rita, and was instead returned to a state of protective equilibrium by redeposition of sediments that had been removed by site excavation prior to passage of the storm. These excavations have resulted in the most significant adverse affects to the site, including removal of archeologically important artifacts and acceleration of erosive chemical, physical, and biological processes.

The wave-current interaction model results indicate strong bottom currents at each wreck site during peak storm conditions. Each site experienced a severe back and forth surge of current velocities ranging from 5.6-7.6 mph in the direction of wave propagation, followed by current velocities of 1.6-2.9 mph in the opposite direction only a few seconds later. The estimated period of this repeating surge cycle ranged from 14.0-16.4 seconds. The wind gusts required to generate equivalent forces on the 4 primary study wrecks would range from 158-215 mph in the direction of wave propagation followed by winds of 44-82 mph in the opposite direction, equivalent to a Category V hurricane on the Saffir-Simpson Scale. The force transferred by wave action to the seafloor becomes greatly magnified as the wave heights build and as the water depth decreases.

A total of 538 items within 154 artifact lots were documented during the artifact cataloging process. Artifact classes include ship-related mechanical items; galley items such as ceramic dinnerware, silverware, and beverage bottles; and personal effects.

STUDY PRODUCT: PBS&J 2011. Impacts of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf. A final report for the U.S. Dept of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-003. 205 pp.

ENVIRONMENTAL STUDIES PROGRAM

Region: Gulf of Mexico OCS Region

Planning Area: Gulfwide

Title: *Social Impacts of Deepwater Horizon along the Gulf Coast*

Estimated Cost: $480,000 **Period of Performance:** FY 2012-2014

BOEM Information Needs to be Addressed: The *Deepwater Horizon* oil spill (DWH) is a watershed event. Many of its direct and indirect socioeconomic consequences emerged quickly while others have continued to evolve to this day. For individuals and households, impacts are expected to include changes in livelihood strategies, for example, because of medium- and longer-term changes in the commercial fishing, recreation and tourism, and offshore petroleum industries. Individuals and households are adapting new sets of options that have resulted from the spill, for example, by participation in mitigation efforts or by relocating to new communities within or outside of the area. The spill has led to changes in hurricane preparation, in environmental awareness, in people's views of their relationships to the coast, and to reemergence of post-Katrina effects and post-traumatic stress-type symptoms. For communities, the incident and its aftermath will affect local businesses, real estate, local tax bases, hurricane and disaster planning, population demographics and dynamics (including relationships between locals and those from outside), and education and social service providers.

A detailed, accurate picture of these short- and long-term, direct and indirect socioeconomic consequences is important to BOEM environmental assessments because DWH has meaningfully changed the GOM socioeconomic baseline. This picture is also important for assessing future impacts. Besides identifying the range of oil spill effects that might occur, it reveals the kinds of causal relationships that can generate them. Finally, the offshore petroleum industry is an important part of the economic and social fabric of the Gulf coast and this picture will provide a more comprehensive understanding of the interactions among the petroleum industry, other economic sectors, communities, families, and individuals.

A detailed, accurate picture will provide support for BOEM environmental assessments and decision-making, and it will address significant concerns of stakeholders in the GOMR. It is also a picture that is extremely difficult to draw. Difficulties arise because of causal complexities, geographic variability, and the emotionally fraught atmosphere in which information gathering must occur. This effort will address these challenges with an experienced staff, a mixed methods approach, and a community-based participatory research model.

Description:

Background: DWH occurred on Mississippi Canyon Block 252, the Macondo prospect, at a depth of 4,993 feet. A blowout, explosion, and fire on April 20, 2010 killed eleven workers. By September 19, 2010, when the well was finally sealed, about 4.9 million barrels of oil had been spilled, 16.5 million gallons of dispersant used, and DWH had become the largest spill in U.S. history. It fouled coastlines across the Gulf of Mexico (GOM), killing birds, marine mammals,

and sea turtles. It hurt tourism where it landed as well as those places perceived to be touched by the spill. It closed areas to recreational and commercial fishing and led to two temporary deepwater drilling suspensions that shocked the Louisiana economy more than did impacts to tourism and fishing. Some social and economic impacts happened quickly, such as effects of closures to commercial fishing and families engaged in it. Others were less immediate but no less consequential, such as those arising from the damage compensation process. The full range of direct and indirect effects are still unknown because they are still morphing into longer-term consequences to commercial and recreational fisheries, tourism, and other commercial and recreational uses of the Gulf coast, to the ways of life of people dependent on them, to the economies, fiscal systems, and public services of communities and coastal states.

Large oil spills are uncommon. Since a spill's characteristics and social and environmental context determines its impacts, outcomes of one do not predict those of the next. DWH followed closely after the 2005 hurricane season and one of the largest natural disasters in U.S. history. DWH affected an area with a diverse economy and population, a society in which the oil industry has a significant role and was itself impacted. Within weeks of DWH, BOEM modified an ongoing study, *Ethnic Groups and Enclaves Affected by OCS,* to address spill effects on families, enterprises, and communities in Gulf coastal areas. Fieldwork was conducted in 2010-11, primarily in coastal Louisiana, Mississippi and Alabama. Study results detail wide ranging and variable effects from the spill and subsequent spill response (Austin et al. draft report). There is no substitute for reliable eyes on the ground to document spill consequences as they unfold. Since socioeconomic consequences of DWH are ongoing and continue to evolve, mid- and longer-term outcomes need to be documented and analyzed with equal care.

Objectives: This project has three major objectives:

1. identify and describe the social, economic, demographic, and cultural effects of the *Deepwater Horizon* oil disaster on the coastal communities of east Texas, Louisiana, Mississippi, and Alabama;
2. identify and describe the fundamental characteristics of the *Deepwater Horizon* oil disaster that induce its social, economic, demographic, and cultural effects, noting similarities and differences to Hurricanes Katrina and Rita and to other major spills, and
3. provide information through analysis of demographic and ethnographic data that is usable for BOEM and state and local agencies.

Methods

This study builds on the strengths, limitations and findings of the earlier BOEM research effort. The multi-disciplinary research team and multi-methods design joins ethnography and its proven strengths at documenting the unfolding, varied, and unique impacts of DWH with more formal analytic methods of demography and its ability to test, generalize and extend such findings. This mix of teams and methods is designed to address conditions and questions detailed by the earlier research effort. It is designed to last 18 months and produce final products. While additional

follow-up efforts to address the unfolding DWH may be warranted, team composition, methods and effort levels will be based on the findings of this effort.

The demography team will develop baseline data files to support the analysis of demographic comparisons of change for the periods 2000-2010 and 2010 and later. These files will include data from sources such as the US census, the 5-percent Public Use Microdata Sample (PUMS) file, the IRS and the Bureau of Labor Statistics and it will cover the GOM states of Alabama, Mississippi, Louisiana, and Texas. Baseline data will be used to analyze the population composition in the four GOM states, with a focus on geographic areas especially affected by DWH as identified by the previous ethnographic research. Items to be included in this analysis include, but are not restricted to, age, sex, race/ethnicity, net migration (in- and outmigration and the characteristics of both migration streams), household characteristics, and industrial and occupational structure by demographic groups. Commute-to-work analysis will be used to match oil and gas industry sectors with occupations to identify communities further inland from the GOM shores that have a concentration of offshore workers.

The ethnography team will collect data in two primary study areas (St. Mary/Lafourche/ Terrebonne/Jefferson LA; Plaquemines/St. Bernard, LA and Harrison and Hancock counties, MS) and two secondary study areas (Golden Triangle, TX, and Mobile and Baldwin counties, AL). Based on earlier research, and in partnership with community researchers in the primary study areas, they will continue to track individuals and businesses in five economic sectors (fishing, tourism, oil and gas, shipbuilding, and retail/service) and, in two study areas, will expand efforts involving (a) local, parish, and state governments, (b) environmental and health organizations, (c) financial professionals, as well as with (d) family and community perspectives outside the five economic sectors. In addition they will systematically collect and analyze research findings from other studies of the DWH disaster and information on the DWH disaster, response and impacts from local, regional, and national media from 2010 through 2012.

These methods are the starting point for the study. Key to the approach is a series of project meetings and information exchanges that will coordinate and integrate the efforts of the two research teams. This sharing of effort will lead to additional questions, tasks, data sources, and analytic approaches.

Revised Date: March 8, 2012

BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Planning Area: Central and Eastern

Title: Shipwreck Research in the New Orleans Notarial Archives (GM-09-x22)

Total Cost: $24,900 **Period of Performance:** FY 2009-2011

Conducting Organization: Earth Search, Inc.

BOEMRE Contact: Melanie Damour

Description:

Background: The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), an agency of the U.S. Department of the Interior, is charged with the responsibility of considering the effects of its actions on significant cultural resources on the Outer Continental Shelf (OSC) of the United States, from state waters to the limit of the Exclusive Economic Zone (EEZ). This program arose out of a variety of legislation enacted to ensure proper management and protection of the nation's cultural heritage. The most pertinent of these laws are the National Historic Preservation Act (NHPA) of 1966 (as amended), the National Environmental Policy Act (NEPA) of 1969, and the Outer Continental Shelf Lands Act (OCSLA) of 1978.

Since the 1970s, BOEMRE (formerly MMS) has contracted several studies aimed at identifying historic shipwrecks that might be present on the OCS. This has resulted in an in-house database with over 3,000 entries, mostly derived from secondary sources and other databases. Despite this effort, several historic shipwrecks have been discovered in industry surveys on the OCS that appear to have no corresponding analog in the BOEMRE database. It was long believed that these vessels were simply lost to the historical record and that documentation on the event of their loss was no longer extant. It now appears, however, that previous researchers overlooked a potentially rich source of information at the New Orleans Notarial Archives (NONA). NONA houses the City of New Orleans notary records from 1733 to 1970. A great many of these records relate to bills of sale, wills, and property inheritance matters, but interspersed among these are recorded "sea protests," which describe in detail any loss of property or accident at sea occurring to any vessel leaving from or arriving at the Port of New Orleans, including shipwrecks. Over 700 such sea protests are believed to be contained within the notarial record books. The notarial records reflect New Orleans' governance at the time of their creation and may appear in French, Spanish, or English.

The BOEMRE has an interest in amassing and assessing this research as part of their mission to protect submerged cultural resources from potential effects of oil and gas-

related activity. The data contained within these documents will assist BOEMRE with identifying the age, function, and nationality of recent and future discoveries of historic shipwrecks on the OCS. This knowledge will also enhance BOEMRE's ability to employ adaptive management strategies in our regulation of OCS oil and gas activities to minimize impacts to significant cultural resources and prevent anthropogenic impacts.

Objectives: The objective of the study is to access the NONA collection to identify historic shipwrecks that may have been lost on the Gulf of Mexico (GOM) OCS. This archival source of historic information has not been previously accessed by researchers and promises to contain a wealth of unknown information about historic shipwrecks in the GOM.

Methods: The objectives of this study will be achieved by locating, copying, translating, transcribing, and cataloging sea protests contained within the NONA collection between 1733 and 1950, to add this information to the existing GIS-based BOEMRE shipwreck database, and to produce a written report. BOEMRE is seeking these sources detailing shipwreck losses occurring within the U.S. EEZ of the northern GOM.

Products: Products may include, but are not limited to, archival and historical documentation, technical report, and a GIS database of shipwrecks.

Importance to BOEMRE: This information will help BOEMRE fulfill its requirements to consider impacts to archaeological resources by oil and gas activities under Section 106 of the NHPA.

Current Status: This study was awarded in September 2009. A post-award meeting was held in October 2009. Archival research was completed in March 2010. A No-Cost Extension of the Period of Performance was requested by the contractor and granted by BOEMRE in December 2010. The current Period of Performance is scheduled to end in June 2011.

Final Report Due:	May 2011
Publications:	none
Affiliated WWW Sites:	none
Revised date:	March 2011
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BOEMRE ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEMRE OCS Region: Gulf of Mexico

Title: Geographic Units for Socioeconomic Impact Analysis in the Gulf of Mexico Region (GM-09-01-04)

Planning Area: Gulfwide

Total Cost: $439,876 **Period of Performance:** FY 2009-2011

Conducting Organization: Coastal Marine Institute, Louisiana State University

BOEMRE Contact: Kristen Strellec

Description:

Background: The BOEMRE defines the analysis area for potential socioeconomic impacts as that portion of the GOM coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. In this description of the socioeconomic environment, sets of counties (and parishes in Louisiana) are grouped for analysis. Currently, BOEMRE develops these groupings based on intercounty commuting zones that have been developed for the U.S. Given the unique commuting patterns related to offshore employment and its unique work schedules (e.g. two weeks on and two weeks off), alternative methodologies for developing geographic areas for social impact analyses are being examined to determine the best approach(es).

Objectives: This study uses industrial cluster analysis, regional input/output analysis and modeling, and geographic information systems in an interdisciplinary effort to identify geographic areas where significant socioeconomic impacts, either negative or positive, are likely to occur. The study is designed as an interactive and iterative exercise involving both an interdisciplinary research team from Louisiana State University (LSU) and BOEMRE staff. The primary objective is to delineate Economic Impact Areas (EIAs) in the Gulf of Mexico (GOM) states that are based on a clear, explicit, empirical rationale, reflective of the onshore effects of the offshore oil and gas industry, and able to more clearly guide and support social impact assessments of industry operations and activities.

Methods: The project is organized into three semi-independent research components. Each component consists of a research team that uses specialized methodologies to address specific project goals. Component one will conduct industrial cluster mapping as a "first cut" identification of areas where significant impacts from the OCS program might be reasonably anticipated; component two shall use multiple regional economic tools like the input/output model to evaluate alternative classifications of OCS-impacted regions, such as those identified in component one of the study, and to identify the unique functional relationships within and among these areas that may be attributable to OCS activity; and the third component shall develop and test indicators of economic development and of such other aspects of development (social participation, human

health, and environmental health), and use these indicators to validate new regions identified by the other two components, to describe socioeconomic characteristics within and among these regions, and to compare regional development between counties that have high OCS activities and those that have low or no OCS activities. These component efforts shall be coordinated and their results synthesized through regular bimonthly meetings.

Products: A final report publication.

Importance to BOEMRE: A better understanding of the onshore geographical distribution of socioeconomic impacts as a result of OCS activity will facilitate better compliance with the goals of the National Environmental Policy Act (NEPA).

Current Status: Several group meetings have been conducted, and a website has been established for project team members to post presentations, findings, administrative reports, and items of interest. The PIs have identified many differences and similarities among the economic areas, labor market areas, and counties that document the distortion of data at the county level under the existing geographic classifications. The Economic Modeling team has begun to identify possible regions based on trade flows of goods and services and patterns of commuting to work between counties. Specifically, results indicate that for the trade data (whether all trade or oil and gas industry specific trade clusters), there are more regions created that cross state boundaries than the regions based on commuting patterns. Identification of the final make up of regions for EIA analysis is yet to be determined. The next steps involve placing demographic and economic characteristics associated with each of the newly created regions and comparing against the baseline on shore area regions defined by BOEMRE. This will help define patterns of similarity and dissimilarity when making final suggestions concerning regional inclusion.

Final Report Due:	September 2011
Publications:	N/A
Affiliated WWW Sites:	None
Revised date:	March 2011
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for this project are unique in relying on sub-bottom profiler data and sediment cores to locate, identify, and evaluate archaeological sites buried below the seafloor. Sites buried below the seafloor contain archaeological information critical to understanding prehistoric human migrations, contacts, and subsistence strategies for time periods and environments not represented in sites currently above sea level.

Products: Final Report of Findings

Importance to BOEM: The BOEM is responsible for managing the economic development of offshore natural resources in federal waters of the GOM. Pursuant to the National Historic Preservation Act, archaeological assessments must be conducted in advance of any ground disturbing activities to ensure that cultural resources are not adversely impacted by, or create hazards to industry development. The proposed research will expand upon the current knowledge base for prehistoric sites in the OCS, and assess if the current survey guidelines are sufficient for accurate interpretations of potential archaeological features. The study will also determine the most accurate and cost-effective methods for identifying archaeological deposits.

Current Status: This study was awarded in August 2007. A post-award meeting was held in October 2007. The first phase of Remote remote sensing operations were completed in July 2008. A total of 6 sites were surveyed. Coring operations were completed in July 2009. A total of 30 cores (totaling 136 sections) were extracted from four separate areas and were processed at LSU. Analysis is complete and a draft report is expected in February 2012.

Final Report Due: September 2012

Publications: Two professional conference papers have been presented on this study:

Evans, A., Oceanographic and Geomorphological Impacts to Potential Submerged Prehistoric Sites. Society for American Archaeology, Atlanta, GA, April 22-26, 2009.

Evans A., Oceanographic and Geomorphological Impacts to Potential Submerged Prehistoric Sites. Conference on Historical and Underwater Archaeology, Toronto, Ontario, January 6-10, 2009.

Affiliated WWW Sites: None

Revised date: December 2011

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