Environmental Studies Program

Studies Development Plan
Fiscal Years 2016-2017

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1: OVERVIEW

1.1 Introduction, Purpose, and Vision

The Bureau of Ocean Energy Management (BOEM), which is within the Department of the Interior (DOI), is the Federal agency responsible for managing the use of energy and mineral resources that are found on the Outer Continental Shelf (OCS) - the 1.7 billion acres of our Nation's continental shelf located beyond State waters. The resources covered include oil and gas; wind, waves, and current energy; sand, gravel, and other minerals. About 18 percent of the oil produced in the United States currently comes from the OCS.

Energy and mineral development have environmental impacts, including oil spills, bottom disturbance, obstructions to migration, noise, air emissions, lighting, vessel traffic, and "viewscape" alterations. Diverse Federal laws task BOEM with protecting the environment as these activities go forward. Environmental protection requires science as well as policy, and since 1973 Congress has funded an Environmental Studies Program (ESP) for this purpose, mandated after 1978 by Section 20 of the Outer Continental Shelf Lands Act (OCSLA). Annual planned funding for the ESP is currently $35.7 million, although the expenditure level has varied over the years. Since its inception, the ESP has provided over $1 billion for research on environmental impacts from energy and mineral development.

BOEM's Studies Development Plans (SDPs) are updated annually and cover the forthcoming two fiscal years. The information in the SDP is used to formulate annual National Studies Lists (NSLs) that describe ESP projects eligible for funding in a given fiscal year. This SDP covers fiscal years (FYs) 2016 and 2017. An overview of BOEM's proposed national and regional research is provided in Chapters 2-6. Tables summarizing new studies that are projected to begin in FY 2016 or FY 2017 are included in Appendix I, and the study profiles for each region are included in Appendix II. Additional information on BOEM's ongoing studies can be found at our studies website: http://www.boem.gov/Current-Research-Ongoing-Environmental-Studies/. Access to completed ESP products through BOEM's web is the Environmental Studies Program Information System (ESPIS) at http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp (BOEM 2013a).

The ESP funds are currently dispersed for defined projects through three vehicles: interagency agreements with Federal agencies; cooperative agreements with State institutions; and competitive contracts. Irrespective of particular funding vehicles and recipients, BOEM aims to use funds in a way that will deliver the most needed and best research at the lowest cost consistent with those objectives.

Between 2010 and 2014, 41 percent of funds went to Federal agencies (26 percent to the National Oceanic and Atmospheric Administration alone); 28 percent to academic institutions; 26 percent to private research organizations; 3 percent to State government agencies; and 2 percent to other researchers. The subject matter allocation of funds over the same time frame was 29 percent marine mammals and other protected species; 28 percent habitat and ecology; 16 percent physical oceanography; 9 percent social sciences and economics; 9 percent fate and effects of oil spills; 5 percent information management; and 4 percent air quality.

ESP projects are developed by BOEM through internal and external review. Overall direction and coordination is provided by the Headquarters Office's Division of Environmental Sciences (DES) within the Office of Environmental Programs (OEP). Input is requested from BOEM's program and regional offices, and priorities are collaboratively developed. Previous to 2015, external review of project priorities was provided by the OCS Science Committee. This was a committee of independent experts established by the Secretary of the Interior under the Federal Advisory Committee Act. In 2015, BOEM entered into a contract with the National Research Council (NRC) to establish a standing Committee on Environmental Science and Assessment for Offshore Energy. The NRC will provide BOEM with advice on diverse issues, and BOEM has decided to secure advice on ESP project priorities from the NRC standing committee instead of the OCS Science Committee beginning with the 2016 SDP. In this transitional year, BOEM will determine priorities through internal subject matter experts. Most importantly for 2015, BOEM will ask the new NRC committee to help the ESP be the best research program in existence. BOEM wants to be second to none, and it recognizes that goal is ambitious and will take work. One approach might be for the NRC committee and the Bureau to identify the attributes of the most successful and respected research programs placed in contexts similar to the ESP; to benchmark the ESP against those programs; to identify steps, as needed, that will incorporate those attributes in the ESP; and then to take the steps identified. BOEM is eager and optimistic about this challenge.

1.1.1 Authorities

Conventional Energy

The ESP was initiated in 1973 as a means to gather and synthesize environmental science and socioeconomic information to support decision-making concerning the offshore oil and gas program. The Outer Continental Shelf Lands Act of 1953, (OCSLA), as amended in 1978, established policies for the management of the OCS oil and gas leasing program and for the protection of marine and coastal environments. Section 20 of the Act authorizes the ESP and establishes three general goals for the program:

- Provide information needed for the assessment and management of environmental impacts on the human, marine, and coastal environments of the OCS and potentially affected coastal areas;
- Predict impacts on marine biota that may result from chronic, low level pollution or large spills associated with OCS production activities, such as from drilling fluids and cuttings discharges, pipeline emplacement, or onshore facilities; and,
- Monitor human, marine, and coastal environments to provide time series and data trend information for identifying significant changes in the quality and productivity of these environments, and to ascertain the causes of these changes.

Early ESP efforts summarized and synthesized available information. Early field studies were designed to provide a statistically valid baseline of the biological, geological, chemical, and physical characteristics of proposed leasing areas. Over the years many changes have occurred. Leasing and development activities for oil and gas are now focused predominantly in the Gulf of Mexico (GOM) with development and leasing activity in Alaska's Beaufort and Chukchi Seas. Some production also occurs off southern California, and future lease sales are planned for

selected areas off the Mid-Atlantic. To address critical OCS information needs, studies conducted in these areas are focused on characterizing environmental processes, determining the presence and abundance of important species, and investigating how species use the habitats.

The OCS Lands Act requires the Department of the Interior (DOI) to prepare a 5-year program specifying the size and location of areas for Federal offshore oil and natural gas leasing and assessing the timing when lease sales will occur. DOI has the role of ensuring that the U.S. government receives fair market value for acreage made available for leasing and that any oil and gas activities conserve resources, operate safely, and take maximum steps to protect the environment. The program operates along all the coasts of the United States – with oil and gas production occurring on the GOM, Pacific, and Alaska OCS (BOEM 2011). OCS oil and gas lease sales are currently held on an area-wide basis, with annual sales in the Central and Western GOM. Less frequent sales are held in the Eastern GOM. Sales in Alaska are focused on the Beaufort and Chukchi Seas, with a special sale in Cook Inlet, dependent upon industry interest, and future lease sales are also now planned for the Mid-Atlantic.

Renewable Energy

The Energy Policy Act of 2005 (EPAct; P.L. 109-58) granted the DOI, which delegated to BOEM, authority to grant leases, easements, and rights-of-way (ROWs) for orderly, safe, and environmentally responsible renewable energy development activities on the OCS. Additionally, the passage of this Act authorized BOEM to find alternative use of existing OCS facilities, and it gave the Bureau responsibilities in not only new frontier "areas" but also in frontier "technologies." Regulations implementing this Act were published in April 2009. There is significant potential for renewable energy from wind, wave and ocean currents offshore, focused along the Atlantic and Pacific coasts. While these nascent technologies are not producing energy on the OCS yet, efforts to support current and future renewable energy activities are underway, including seven areas along the Atlantic that are currently leased.

Marine Minerals

OCSLA Section 8(k) provides the authority to manage minerals on the OCS. The DOI jurisdiction for leasing and regulating the recovery of minerals extends to the subsoil and seabed of all submerged lands seaward of State-owned waters to the limits of the OCS (except where this may be modified by international law or convention or affected by the Presidential Proclamation of March 10, 1983, regarding the Exclusive Economic Zone (EEZ)). The OCSLA does not authorize BOEM to issue prospecting permits or leases to private interests in the territorial waters of a commonwealth or territory of the United States.

Regulations governing non-energy, competitive mineral prospecting, leasing, and production are in 30 CFR Part 580 (commercial prospecting), Part 581 (leasing), and Part 582 (commercial production).

Public Law 103-426 (43 U.S.C. 1337(k)(2)), passed in 1994, allows the Bureau to negotiate, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for shore protection, beach or wetlands restoration projects, or for use in construction projects funded in whole or part by or authorized by the Federal Government. A 1999 amendment to the law prohibited BOEM

from charging federal, state and local government agencies a fee, directly or indirectly, for using OCS sand.

For all other uses, such as private use for commercial construction material, the competitive bidding process is required for issuing leases. To date, the vast majority of the leases and agreements issued by the Marine Minerals Program (MMP) have been negotiated noncompetitive agreements for sand. The MMP is also responsible for other non-energy minerals such as strategic mineral resources containing copper, lead, zinc, gold, platinum, and rare earth minerals. Developers have periodically expressed interest in obtaining leases to develop these resources; however, there have been no leases issued for these resources and there are no pending lease requests at this time.

1.1.2 Responsibilities

The ESP manages applied science research with direct relevance to the agency's environmental assessment needs. BOEM's Office of Environmental Programs (OEP) conducts environmental reviews, including National Environmental Policy Act (NEPA) analyses, and produces compliance documents for each major stage of energy development planning. These analyses inform BOEM's decisions on the Five-Year Oil and Gas Program, renewable energy development, and marine mineral leasing activities.

BOEM develops the Five-Year OCS Oil and Natural Gas Leasing Program; oversees assessments of the oil, gas, and other mineral resource potential of the OCS; inventories oil and gas reserves and develops their production projections; and conducts economic evaluations that ensure the receipt of fair market value by U.S. taxpayers for OCS leases. BOEM also conducts the Oil and Gas Lease Sales, Sand and Gravel negotiated agreements, and it creates official maps and geographic information system (GIS) data.

BOEM's Office of Renewable Energy Programs (OREP), located in Sterling, Virginia, implements and manages the agency's offshore renewable energy responsibilities. OREP grants leases, easements, and rights-of-way for orderly, safe, and environmentally responsible renewable energy development activities.

The MMP is comprised of Headquarters staff in the Office of Strategic Resources and Office of Environmental Programs based in Sterling, Virginia, and Gulf of Mexico staff in the Office of Environment based in New Orleans, Louisiana. The MMP manages and issues leases for non-energy mineral resources excavated from the OCS. The Program ensures that environmental damage to marine and coastal environments, in association with the use of these resources, is avoided, minimized, and/or mitigated. To date, all MMP-related leases have been issued for projects located along the Atlantic and Gulf coasts. Additional information regarding the MMP's executed leases and shoreline restoration projects may be found at http://www.boem.gov/Marine-Minerals-Program/.

BOEM's planning process links its activities to the DOI's Strategic Plan (DOI 2014) in the following mission component areas: powering our future and responsible use of the nation's resources and ensuring healthy watersheds and sustainable, secure water supplies. Careful planning ensures that goals and strategies are cascaded throughout the organization. BOEM's

strategies also guide the development of budget documents, which are used as input for planning, and performance documents in support of ongoing efforts to build a Department-wide strategic plan. BOEM's ongoing work to oversee offshore energy and marine mineral exploration and development on the OCS, from lease offerings to lease abandonment, also addresses multiple mandates to ensure safe and sound operations, minimize impact on the environment, and achieve fair market value. This work includes ongoing critical research on the environment and preparation of rigorous environmental assessments for proposed development-related activities. The environmental research component is conducted through the ESP.

BOEM has close ties to its sister bureau, the Bureau of Safety and Environmental Enforcement (BSEE), and helps support its environmental science needs. BSEE promotes safety, protects the environment, and conserves offshore resources through vigorous regulatory oversight and enforcement. BSEE has three main functions: 1) developing standards and regulations to enhance safety and environmental protection for the exploration and development of offshore oil and natural gas on the U.S. OCS; 2) reviewing industry Oil Spill Response Plans (OSRP) to ensure compliance with regulatory requirements; and 3) focusing on compliance by operators with all applicable environmental regulations, as well as ensuring that operators adhere to the stipulations of their approved leases, plans, and permits.

BSEE is also supported by three Administrative Offices (New Orleans, Louisiana; Camarillo, California; and Anchorage, Alaska) that are responsible for reviewing Applications for Permit to Drill, which ensure that all of the recently-implemented enhanced safety requirements are met, and for conducting inspections of drilling rigs and production platforms by using multi-person, multi-discipline inspection teams. BSEE maintains the new National Offshore Training and Learning Center; operates Ohmsett, the National Oil Spill Response Research and Renewable Energy Test Facility, in Leonardo, N.J.; and manages the Technology Assessment Programs to advance research in safety, engineering, and offshore standards (BSEE 2011).

1.1.3 Resource Estimates and Production

The 1.7 billion-acre OCS is a significant source of oil and gas for the Nation's energy supply. In FY 2014, the approximately 36 million acres on active OCS leases (BOEM 2015a) generally accounted for about 8 percent of America's domestic natural gas production and about 24 percent of America's domestic crude oil production (BOEM 2015b). Together, BOEM and BSEE apply oversight and regulatory frameworks to ensure that exploration, installation, operations, and decommissioning proceed safely and in an environmentally responsible manner.

The offshore areas of the United States are estimated to contain significant quantities of resources in undiscovered fields. BOEM estimates of technically recoverable oil and gas resources in undiscovered fields on the OCS are 90.0 billion barrels (bbls) of oil and 404.6 trillion cubic feet (cf) of gas (BOEM 2015c).

1.2   Overview of BOEM's Program Direction and Research Support

1.2.1 Use-inspired Science

BOEM's ESP takes a science-informed strategic planning approach to provide valuable input to decision-making processes. In regards to scientific research, the term "use-inspired" refers to the idea that the quest for fundamental knowledge may be integrated with the desire to inform decisions on practical problems. Scientific research that is use-inspired, therefore, may lead to a broader fundamental understanding of phenomena being examined. ESP-supported efforts seek to explore the continuum of learning through discovery and application while concurrently providing invaluable information to support management decisions.

National attention has been directed towards the ESP's performance measures and accountability. The Environmental Studies Program Performance Assessment Tool (ESP-PAT) was designed and implemented in 2005, and it is an internal, online system used to monitor the effectiveness of ESP products in fulfilling the Bureau's information needs. This tool also tracks the program's efficiency in delivering products on time. While designing performance measures for research programs has always been viewed as problematic, the ESP-PAT has accomplished this task, ensuring that the ESP fulfills its mission of providing the best possible scientific information for making decisions concerning our offshore resources. The ESP also reports on measures under the Renewable Energy High Priority Performance Goal (HPPG), and the ESP reports the percentage of environmental studies for renewable energy information needs awarded (including hybrid studies that benefit renewables) in a given FY. The ESP typically meets or exceeds the established targets for ESP-PAT and HPPG metrics.

1.2.2 Credibility and Integrity

To ensure consistency and transparency, the ESP follows a robust set of procedures that include multiple levels of review and approval. Research projects are identified and selected on an annual basis with an emphasis on relevance to the missions of the Bureau and also the scientific merit of the study efforts. Studies must be technically feasible and timed appropriately both to use information from other efforts and to be delivered in time for relevant documents and decisions. The ESP is measured and documented to be effective and efficient in delivering relevant information in a timely fashion. The results of BOEM-funded research are presented both domestically and internationally to a variety of audiences, including professional and academic societies, industry forums, and governmental workshops. These events spread our scientific information to wide audiences, and many of our projects have opportunities for educational components.

Scientific Integrity Policy

The Department of Interior's Scientific Integrity Policy calls for the use of science and scholarship to inform management and public policy decisions and establishes scientific and scholarly ethical standards. In addition, the policy includes codes of conduct, a process for the initial handling of alleged violations, and clear guidance of how employees can participate as officers or members on the boards of directors of non-Federal organizations and professional societies. This policy applies to all Department employees, including political appointees, when they engage in, supervise, manage, or influence scientific and scholarly activities; communicate information about the Department's scientific and scholarly activities; or utilize scientific and scholarly information in making agency policy, management, or regulatory decisions. Further, it applies to all contractors, cooperators, partners, permittees, and volunteers who assist with developing or applying the results of scientific and scholarly activities. The policy and supporting information can be found at: http://www.doi.gov/scientificintegrity/index.cfm.

General Peer-Review Planning

Section V of the Office of Management and Budget's (OMB) Final Information Quality Bulletin for Peer Review (EEOB OMB 2004) requires that agencies have "a systematic process of peer review planning" and publish a "web-accessible listing of forthcoming influential scientific disseminations (i.e., an agenda) that is regularly updated by the agency." Numerous mechanisms within the ESP identify and fulfill the requirement for scientific peer review. These existing mechanisms include:

Internal review of study profiles by BOEM scientists,

External review of study profiles by other Federal and nongovernmental scientists,

Review and critical input by Scientific Review Boards or Modeling Review Boards,

Scientific peer review of final reports, and/or

Publication in peer-reviewed technical and/or scientific journals.

Each project is evaluated for the appropriate level of peer review required for the particular effort. These measures begin early in the development stages, and continue during the course of projects. These components taken together ensure that the science produced by the ESP is of the highest quality and, thus, creates a sound basis for decision-making.

Partnering and Leveraging Efforts

The ESP regularly encourages inter- and intra-agency study collaborations with BOEM's Federal agency partners, and many of BOEM's important and award-winning research efforts were completed through the cooperation with agencies such as the United States Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), and the United States Navy's Office of Naval Research (ONR). BOEM also has also established partnerships with the States of Louisiana and Alaska through their respective Coastal Marine Institutes (CMIs), and the Bureau is also a member of several Coastal Ecosystem Studies Units (CESU) networks, which enable it to efficiently establish cooperative agreements with state-owned institutions.

In addition, BOEM actively coordinates efforts with programs such as the National Oceanographic Partnership Program (NOPP). NOPP is a collaboration of Federal agencies that provides leadership and coordination of national oceanographic research and education initiatives. NOPP addresses objectives that are too big for any one state or federal agency. NOPP adds significant integrative value to the individual oceanographic, ocean science, resource management and ocean education missions of the Federal agencies and their partners, in common pursuit of the wise use of the oceans and the maintenance of their health. As a charter member of NOPP, the ESP continues to explore options to increase its participation, and its investments have grown dramatically in recent years. The ESP has funded research through NOPP focused on chemosynthetic communities, biological habitats supported by shipwrecks, surface circulation radar mapping in Alaska, improving cetacean electronic data loggers, and a variety of renewable energy projects. Several studies have received the NOPP Excellence in Partnering Award and also DOI's Partners in Conservation Award.

Information Management and Dissemination

While the goal of the ESP is to gather and synthesize environmental science and socioeconomic and cultural resource information to support decision-making concerning the offshore program, the information must be available in a usable form and distributed in a timely manner. The ESP follows codified, standard operating procedures for the distribution and use of study results to ensure that they are distributed quickly to all relevant parties and users of the information. This rapid information dissemination is a key management activity. ESPIS provides an important resource for information availability. Full-text files, abstracts, and relational databases are searchable through the system, which allows users to easily search for, identify, and select sections of text or bibliographic citations that relate directly to the desired subject.

Planned enhancements of the ESPIS database will make all completed ESP reports and other deliverables available online as full electronic portable document format (PDF) documents. ESPIS will be linked to the Multipurpose Marine Cadastre (Multipurpose Marine Cadastre, 2013) to create a tool to search geospatially for reports and data from completed environmental studies (http://www.marinecadastre.gov/default.aspx). It is envisioned that ESPIS will facilitate information sharing for NEPA assessments, oil and gas and alternative energy leasing, and inform Ocean Planning initiatives.

Information concerning ongoing research supported through the ESP is accessible at: http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Current-Research.aspx (BOEM 2015d). The ongoing research is arranged by BOEM OCS Region and discipline (e.g., biology, socioeconomics, physical oceanography, fates and effects, etc.). Information provided for each study includes a complete description, status report, cost, and expected date of its final report. Affiliated web sites, presentation abstracts, and papers are provided where applicable.

Outreach and Education

BOEM, like many other Federal agencies, will need to replace its marine scientists and engineers as they retire. The agency, therefore, must be able to attract well-qualified marine scientists and engineers to meet expanding and changing workforce needs. Since there is a shortage of marine

scientists in general, BOEM faces competition from other employers in and out of government. At the same time, the ESP needs and will continue to need well-qualified marine scientists to conduct program-funded research. The ESP undertakes a number of activities to encourage students in their academic training and provide young professionals with opportunities to succeed in their careers. These activities are in support of the ESP's education goals of: 1) an ocean literate public, 2) a pipeline of marine scientists to meet ESP needs either through employment at BOEM or at universities, and 3) an ocean literate marine workforce. To achieve these goals, the ESP undertakes a number of activities aimed at increasing ocean literacy and building a strong marine workforce.

ESP studies using cooperative agreements with universities often use undergraduate and graduate students as part of the research team, and these students sometimes use the research results for their Master's thesis or doctoral dissertation. Some of those students enter an academic career and occasionally continue to conduct ESP research through their university. At some point in their career, these students may enter government service, which might include employment at BOEM. Either way, research teams on ESP-funded projects using undergraduate and graduate students contribute to the training and career development of the next generation of marine scientists.

To encourage high school students interested in the marine sciences, the ESP provides financial support to the National Ocean Sciences Bowl (NOSB), which is a high school competition. The NOSB provides BOEM with the opportunity to develop links to the pre-college community and allow students to be aware of career opportunities in the marine sciences and in the Federal government, and BOEM is profiled in the NOSB career booklet, "An Ocean of Possibilities! Careers Related to the Ocean and Aquatic Sciences." The NOSB reaches out to students and communities to increase participation by minorities, women, and disadvantages students, which supports BOEM's goal of a diverse workforce.

CHAPTER 2   NATIONAL PROGRAM

2.1   Introduction

BOEM's Headquarters Office provides national context for the ESP and supports linkages among the Bureau's other regional offices and OEP. While most of BOEM's regional offices focus on research and information needs for specific geographic areas, studies initiated by OEP at the Headquarters Office are predominately national in scope and have program-wide applications. Headquarters may also develop studies with other Federal agencies, universities, or other external partners in order to leverage resources and foster collaborative relationships. Research projects are identified and selected on an annual basis with an emphasis on mission relevance and scientific merit. Studies must be technically feasible and delivered in time to inform relevant documents and Bureau decisions. Efforts are made to incorporate and build upon the findings of previous efforts.

The ESP at Headquarters is guided by four main principles: 1) studies conducted by BOEM must be use-inspired so that determined results may be applied towards management decisions; 2) research supported by the Bureau must be held to the utmost scientific integrity and credibility; 3) partnerships should be sought, whenever possible, to leverage funds with other interested Federal, State, and private stakeholders to maximize the utility of results and extend limited budgets; and 4) the Bureau will engage regularly with stakeholder and public educational outreach for quality assurance, peer-review planning, and data dissemination. ESP at Headquarters, overall, provides leadership and general program support for all of BOEM's studies.

To ensure consistency and transparency, the ESP at the Headquarters Office also follows a robust set of procedures that include multiple levels of review and approval. All study products are publically available via the BOEM website (www.boem.gov/Environmental-Studies-EnvData/). Results are presented both domestically and internationally to a wide variety of audiences, including professional and academic societies, industry firms, and governmental workshops. As previously mentioned, the Headquarters Office also understands the value of public outreach, and it strongly encourages its studies to have an educational outreach component whenever possible, and many projects include opportunities for public engagement; examples include taking a teacher to sea, developing curriculum materials for students, and producing videos and posters.

2.2   Conventional Energy Science Strategy

Habitat and Ecology

A critical part of BOEM's mission is to protect the environment while ensuring the safe development of the nation's offshore energy and marine mineral resources. To inform BOEM decisions, OEP is planning to co-sponsor the Sixth Symposium on Deep-Sea Corals and is developing several marine studies that examine the impacts of resource exploration, development, and extraction on the habitat and ecology of the OCS.

Three of these proposed studies will use telemetry to track marine animals and examine habitat use. Animal telemetry can provide relevant information across program areas such as wind and hydrokinetic placement locations, oil/gas leasing, and Geological & Geophysical (G&G) surveys. In addition, telemetry may offer a deeper understanding of ecosystem dynamics by associating migratory, reproductive, and feeding behavior with simultaneously observed oceanic properties such as temperature, salinity, pH, etc. as well as recorded animal vocalizations. The results of these studies will be useful for NEPA, Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA) consultations and the data will be used to create ecological models and will be shared with federal partners through the creation of a national telemetry network.

Another study will use high-resolution aerial imaging for surveying marine animals of interest (e.g. whales, birds, and sea turtles). This method has already been tested by BOEM through a pilot study. This project will inform BOEM of the distribution and abundance of marine animals as well as human use in the marine environment. Products resulting from this study will be used for NEPA analysis, region specific environmental assessments, review of applications for permits, and development of the Five Year Plan for Oil and Gas Development.

Marine Mammals and Protected Species

Certain marine species are federally protected by law under the ESA and the MMPA. BOEM is responsible for ensuring that its actions to not cause harm to the animals protected by these laws. The National Environmental Policy Act also provides protection against harming habitats and species. One of the major focus areas of BOEM's environmental studies is determining possible impacts of offshore energy exploration and development on these protected species and exploring possible mitigations.

BOEM is examining the behavioral response of humpback whales to sounds produced during seismic surveys, such as from air gun arrays, and is comparing results with behavioral patterns observed when these animals are subjected to normal ship traffic sounds where these survey tools are not used. Results from this research effort will allow the Bureau to more effectively mitigate the use of acoustic survey techniques in specified locations.

Physical Oceanography

BOEM understands that determining how sound propagates in the ocean is a complex problem made so by the multiplicity of physical factors determining the acoustical properties of the ocean. The irregular and changing shape of the sea surface, the presence or absence of sea ice, the shape and composition of the sea floor, and the time and space varying temperature, salinity, and water pressure all determine how sound generated in a given location will propagate. A planned study will estimate the error in computing sound pressure levels and sound exposure levels from industrial sources resulting from the spatial and temporal variation of physical conditions of the prevailing sea water, including ice cover and sea state. These estimations will consider as many locations as practical where offshore energy development is likely in the near future and will feature appropriate 3-D propagation models to reduce the effect of biases or weaknesses.

The Headquarters Office provides integration of BOEM's physical oceanographic studies to support Oil Spill Risk Assessment (OSRA). The mechanisms of physical oceanographic processes and other features in the ocean and the atmosphere control the transport of materials and cause the mixing and redistribution of pollutants. The knowledge and information obtained from the physical oceanography and meteorological studies are used for assessing: 1) the transport of spilled oil; 2) the dispersion of discharged fluids and produced water; 3) the movement, spread, and precipitation of air pollutants; and 4) the effects of ocean conditions on the migration of marine mammals, the distribution of fishes, and impacts to other biological resources. BOEM is committed to the continuous improvement of its OSRA estimations and is using the results of field and modeling studies of ocean circulation to fulfill that commitment. As part of this effort, the capability to present results in a geographic format is being implemented.

Information Management

BOEM is tasked under the National Ocean Policy (NOP) Implementation Plan to support a national ocean data portal (ocean.data.gov), which is a shared Federal resource available to all of the Bureau's stakeholders and to the general public. Special focus, however, needs to be given to improving the presentation and discovery of avian biology measurements. These measurements will contribute to a variety of decisions concerning OCS renewable energy development, and the greater exposure of these measurements through a data portal will increase the openness and transparency with which BOEM makes regulator decisions. The Bureau also needs to rigorously test the effectiveness of all of its mitigation and monitoring requirements so it may improve the quality of its management responsibilities.

BOEM is also currently faced with implementing an ecosystem-based management approach to the siting and development of offshore energy installations along the OCS. Specifically, public comment periods associated with future programmatic Environmental Impact Statements (EISs) is an opportunity to engage stakeholders in a process of transparent decision-making that explicitly weighs the ecosystem costs and benefits of developing ocean energy. The MIDAS and the MIMES may be used to facilitate a process of stakeholder engagement that lays the foundation for the continued development of EBM approaches for BOEM in the future.

Anthropogenic-based ocean sound and noise continues to be a significant environmental concern for BOEM and many of its stakeholders. This is a central issue across all of the Bureau's program areas and regions, and there is a constant need to not only support further research on this topic but also gain access to the latest scientific and management information. Therefore, BOEM plans on supporting the Fourth International Conference on the Effects of Noise on Aquatic Life; this conference is held every three years, and it provides excellent information on scientific information and regulatory strategies in various jurisdictions. BOEM will also propose the expansion and standardization of Tethys, a passive acoustic monitoring metadata database system, so that it is more usable for scientific and government communities.

2.3   Renewable Energy Science Strategy

The President and the Secretary of the Interior have highlighted the importance of understanding impacts caused by climate change (Executive Order 13653; DOI Order 3289), and they

specifically identified the importance of understanding its impacts on society. BOEM, therefore, is building upon an existing multi-agency effort, titled the Human Dimensions of Climate Change (HDCC), which will support the Bureau's environmental assessment activities associated with OCS activities. Specifically, information derived from this study will enable the Bureau to define the current impacts of climate change and more accurately define future baseline environmental conditions in Oregon. Further, data on the social, cultural and economic impacts of climate change will enable the Bureau to more accurately forecast cumulative impacts, a particularly challenging task within the NEPA analysis process. This study will then allow BOEM to evaluate the utility of the information collected through this modified approach and if deemed useful could be followed up by duplicate studies in other OCS Regions.

BOEM is supporting science and information needs for marine planning through its engagement with Regional Planning Bodies (RPBs). The National Oceanographic Partnership Program (NOPP) provides a framework to further strengthen this engagement by collaboratively working with RPBs (particularly in the Atlantic and Pacific regions) and other federal agencies to identify common science needs and funding these through Broad Agency Announcements (BAAs). This framework has been successfully leveraged in the past and could provide a platform to support expanding information needs for preparing regional ocean plans.

The Department of Energy has funded several offshore renewable energy demonstration projects with the intent of construction being complete by 2017. The construction of the first turbines in the offshore environment will provide an opportunity to collect real-time observation of environmental impacts as these projects are completed. BOEM has an ongoing study, RODEO (Real-time opportunity for Development Environmental Observation), that allows for the collection of important environmental data for these pioneer projects.

2.4   Marine Minerals Science Strategy

The marine minerals science strategy is centered around responsible stewardship of the finite suitable sediment resources on the OCS that support coastal resilience and habitat restoration. Although projects to date have been focused along the Atlantic and Gulf coasts, MMP's science strategy and proposed studies apply nationwide.

Coastal erosion and storm damage affect the sustainability and value of coastal ecosystems and economies, and they also pose serious challenges that affect tourism, energy development, public lands, defense, and other strategic infrastructure. Storm damage remediation and coastal resiliency measures, therefore, are of national importance. The extent and magnitude of shoreline impacts are compounded by poor coastal management decisions and changes in sea level and storm characteristics driven by climate variability. The toll of extreme storms, such as Hurricanes Katrina and Sandy, renewed a national focus on the importance of long-term coastal resiliency along the Gulf and Atlantic coasts. Hurricane Sandy damage triggered a wide range of emergency management initiatives along the entire Atlantic coast for multiple U.S. Army Corps of Engineers (USACE) coastal storm risk management projects (i.e. beach nourishment). A growing number of these Federal projects, already authorized or awaiting authorization, require OCS sediment resources to support their short and long term needs. Additionally, a large number of non-Federal beach nourishment project sponsors continue to pursue OCS sand resources in support of their locally-funded efforts.

The MMP must comply with numerous environmental statutes, regulations, and executive orders to carry out its mission. Information obtained through studies investments is used to inform environmental assessment and leasing decisions concerning the use of OCS sand resources. Based on the current data needs identified in past assessments and input received through coordination with stakeholders, MMP is proposing environmental studies to support the following principal areas of focus:

> Identify and fill data gaps on resources of concern in advance of project implementation to inform NEPA and other relevant consultation documents and avoid, minimize, and/or mitigate impacts accordingly.

> Contribute to strategic stakeholder engagement and regional partnering initiatives to identify and implement effective resource management strategies.

> Utilize data associated with regional G&G investigations of potential sediment resource areas to support programmatic consultations within the Atlantic and GOM OCS in order to more strategically manage impacts.

The MMP also hosts regional Sand Management Working Groups (SMWG) throughout the Atlantic and Gulf states to encourage discussion about past, ongoing, and future projects, potential environmental concerns, study needs, and lessons learned. Active stakeholder engagement through the SMWG's and participation in regional planning groups (e.g. Northeast Regional Ocean Council (NROC), Mid-Atlantic Regional Council on the Ocean (MARCO), Gulf of Mexico Alliance (GOMA, etc.)) ensures that the MMP maintains connectivity with decision makers throughout the Atlantic and Gulf regions and aligns study investments with priority needs.

Fates & Effects

Sand access and potential environmental resource conflicts are becoming more complex and deserving of rigorous and integrated environmental study, monitoring, and management. Thus, a comprehensive understanding of offshore geology and the associated physical and biological processes occurring within OCS sediment resource areas on a regional scale is critical to responsibly managing the use of these finite resources.

MMP is working with the environmental resource agencies and other interested stakeholders to take a more strategic regional sand management approach to more effectively manage OCS resources and environmental impacts. Regional-scale geological, geophysical, and biological data collection efforts, pre and post use, are being pursued to support this goal. Coupled with these regional data collection efforts, the MMP is pursuing a programmatic Essential Fish Habitat (EFH) consultation with the National Marine Fisheries Service (NMFS) Habitat Conservation Division (HCD). The goal of this programmatic consultation is to more holistically evaluate and manage EFH impacts and promote efficiencies in the leasing process. This can be accomplished by 1) evaluating the long-term and cumulative effects of dredging across a specified regional scale and 2) assessing the effectiveness of subsequent mitigation measures relative to specific managed fish species and their habitat features.

Habitat & Ecology

In FY 2016, the MMP is proposing to develop a programmatic geospatial framework to improve classification and management of potential offshore sediment resource features and correlation with specific species use and habitat value. The MMP needs to identify and geospatially correlate specific geomorphologies with habitat types and EFH at a regional scale. This geospatial analysis will support the development of a programmatic EFH consultation by enabling the MMP to better predict cumulative effects and design targeted mitigation strategies within specific habitat categories.

In addition to the continued efforts to refine targeted mitigation strategies to avoid and/or minimize the effects of dredging sediment resources, the MMP also recognizes that there may be habitat improvements following dredging activities and studies evaluating these opportunities are limited. The MMP is proposing investments in assessing the potential for "engineering with Nature" design approaches. Specifically, identifying borrow area design parameters and associated construction methodologies that increase habitat value from pre-dredge conditions. The study proposes to evaluate existing literature documenting specific factors supporting high valued offshore fisheries habit within varying offshore sand resource areas (i.e. geomorphologic features and associated physical dynamics that drive productivity) coupled with an investigation of feasible and cost effective engineering with nature measures that maximize post dredging habitat value. This information is vital in the development and management of OCS mineral resources to fully understand the impacts, both positive and negative, of BOEM's actions. Particularly in regards to NEPA and EFH assessments. .

Social and Economic Sciences

MMP is pursuing collaborative opportunities with the USACE Regional Sediment Management (RSM) program to quantify the cumulative contributions of past and future OCS sediment resources to the littoral system via beach nourishment, providing a valuable positive benefit to the regional sediment budget. As the availability of more cost-effective nearshore state sediment resources become depleted, there is increased emphasis on identifying additional resources within the OCS. Realizing that the distance of a sediment resource from the placement area is one of the primary cost drivers, it is important to begin evaluating the monetary and nonmonetary tradeoffs among borrow area options. One of the perceived benefits of using offshore OCS resources is that new sediment is introduced into the coastal sediment budget, as opposed to using limited nearshore sources that are often part of the active coastal system, thereby improving project sustainability and geomorphic function.

MMP is also completing a study in partnership with Louisiana State University's (LSU's) Coastal Marine Institute (CMI) to understand the relative contribution of using OCS sediment versus nearshore sediment to long-term coastal restoration project effectiveness, cost, and contribution to the regional sediment budget. These data will provide information about the overall "value" of OCS sand relative to alternative nearshore sources and support borrow area tradeoff analyses and associated cost justifications. Specifically, though it may cost more to obtain sediment from the OCS due to dredge plant limitations, pumping constraints, or other reasons, the cost of dredging these resources may be justified when considering the long-term need to supplement the sediment budget deficit and the avoidance of potentially more significant

resource implications and mitigative costs associated with nearshore sources. This study seeks to provide a baseline understanding and quantification of the economic, ecologic, geomorphic long-term benefits of using OCS sediment versus nearshore sediment for coastal restoration projects.

2.5   Future Plans

2.5.1 Programmatic Objectives and Future Plans

BOEM's ESP relies on the expertise of its regional offices to prioritize study needs in geographically-specific areas. The national office attempts to balance regional science needs with broader research foci which address knowledge gaps in multiple regions or advance the entire program through enhancement of information gathering and management. The future plans of the ESP are also informed by the ocean science and technology priorities identified by the Subcommittee for Ocean Science and Technology (SOST) under the White House's Office of Science and Technology (OSTP). Alignment with these higher-level priorities allows BOEM to leverage efforts and resources within the interagency. Within this prioritization framework, the ESP plans to focus future research in the areas of ecosystem-based management, Arctic science, understanding climate impacts on the ocean, ocean observations and modelling, and data accessibility and management. To ensure a broader understanding of ecosystems, international partnerships will also be pursued. These partnerships may involve working with Mexico and possibly Cuba in the Gulf of Mexico region. Considering Mexico recently joined the International Offshore Petroleum Environmental Regulators (IOPER) forum this venture seems timely. As the US will soon be leading the Arctic Council, the timing is right to pursue broader Pan-Arctic ecosystem collaborations. This engagement should occur with consideration to the Interagency Arctic Research and Policy Committee (IARPC), U.S. Global Change Research Program (USGCRP), and the SOST priorities. And finally, BOEM will be hosting the IOPER Annual General Meeting in October 2015, which provides an opportunity to discuss ocean science research needs of mutual interest with the environmental regulators from member countries.

Ecosystem-Based Management

Scientific understanding is essential to comprehending the fundamental structures, functions, processes, and human and natural interactions that shape marine ecosystems and the services and products they provide. Integrated research is needed to assess and predict the potential ecological and socioeconomic effects of human and natural impacts on ecosystems. Sound ecosystem-based management (EBM)[1] depends on the availability of reliable, accurate, and actionable ecological, social, and economic information. The ESP has conducted several studies which apply these precepts of EBM to its design. BOEM will continue to pursue study designs which evaluate multiple systems and impacts simultaneously. These studies may include suites of studies which are comprised of coherent units which combine to provide a more holistic impression of the ecosystem. These plans also include improving the incorporation of scientific data and

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[1] As defined in *Implementing Ecosystem-Based Management: A Report to the National Ocean Council*, Ocean Research Advisory Panel, December 2013. (http://www.nopp.org/wp-content/uploads/2010/03/Implementing-EBM-v4.pdf).

predictive models, such as climate change projections, to enhance risk assessments and decision making.

Arctic Science and Climate Change

Planet-scale changes in the climate system can have significant effects on the nation's valuable coastal and ocean ecosystems including changing sea levels, temperature, circulation, chemistry, productivity, diversity, and ecosystem and public health. These changes can both positively and negatively impact the natural and human ecosystems along the OCS and neighboring coasts. Rapid changes are being observed in the Arctic marine system as Arctic air temperatures increase at three times the rate of the rest of the globe. The consequences of rapid environmental change have significant ramifications on the health and well-being of people and communities, and impact economic development and homeland and national security.

In order to manage the nation's offshore energy and mineral resources in a responsible, scientifically-informed manner, BOEM must understand how global change will impact marine ecosystems and how these additional stressors might amplifying the potential impacts of energy exploration and development.

Ocean Observations and Modelling

Observations of the ocean improve our understanding of weather, climate, ecosystems, and ocean conditions, allow us to forecast key environmental processes, and strengthen resource management decision-making at all levels. Enhanced observing capabilities and capacity strengthen nearly all aspects of BOEM's science enterprise. BOEM will seek to sustain and advance ocean and observing system infrastructure through both the incorporation of existing ocean observing systems into future study designs and contributing to these systems through capital improvements and expanding observation networks.

Data Accessibility and Management

The ESP has made data accessibility and management a priority, as demonstrated through the regular updating of ESPIS and the ongoing efforts to improve our information systems (geoESPIS). In the future, ESP plans to develop and improve upon existing information management systems to support archival capability for and access to observational data and derived information, including socioeconomic data. Improvements on the ESP websites are also a priority.

Additionally, the MMP has been compiling historic sand resource data collected over the past 20+ years as well as new information from Hurricane Sandy funded initiatives into a comprehensive GIS database. The MMP will use this geospatial database to inform decision making based on resource availability, location, volume, and other characteristics important to coastal restoration managers. MMP will expand this database in the future to incorporate other considerations such as EFH, hard-bottom areas, wind energy transmission lines, oil and gas pipelines, and sensitive cultural resources to help identify conflicts and contemplate impact trade-offs.

The development of a comprehensive inventory of delineated sand resources within the Gulf and Atlantic OCS is the first step towards informing decision making on a regional scale.

Dredging technologies are currently a limiting factor in cost effective solutions for dredging the OCS and must be carefully considered in resource management decisions.

To better inform the cost parameters of OCS sediment resource extraction, the MMP is interested in evaluating opportunities for new innovative dredging technologies to reduce OCS dredging costs. The purpose of this study would be to evaluate the international technological advancements as well new innovative and cost effective methodologies for long distance conveyance of sediment. BOEM continues to study how dredge areas evolve and potentially impact infrastructure and/or resources of concern located adjacent to the pit. However, site-specific data required to make accurate predictions and empirical measurements to test and validate predictive models are only available for a few of the OCS borrow sites because of a lack of a comprehensive borrow area monitoring program.

This initiative would involve development of a comprehensive, systematic and repeatable framework for acquiring data (time series seafloor surveys, instrument deployment, etc.) at representative borrow areas on the OCS. This effort will build on BOEM's investment toward better understanding this problem by filling data gaps and refining predictive models developed during previous studies. It will also evaluate the effectiveness of mitigation measures applied to existing borrow areas (e.g. setback distances from pipelines or hard bottom benthic habitats) to determine if resources and infrastructure are being protected. Results will increase BOEM's decision making ability regarding safety and protecting environmental and cultural resources and provide for better management of valuable OCS sand resources. The influx of projects that MMP is presently experiencing on both the Gulf and Atlantic OCS will provide a unique opportunity to document baseline conditions and implement a monitoring program immediately after dredging has been completed.

CHAPTER 3   ALASKA STUDIES

3.1 Introduction

The Alaska OCS encompasses 15 planning areas in the Arctic, Bering Sea, and Gulf of Alaska sub-regions (Figure 6.1). BOEM's Alaska Office oversees more than one billion acres on the OCS and more than 6,000 miles of coastline, which is more coastline than in the rest of the United States combined. The vastness of the Alaska OCS presents many challenges for working in the region, including the following: large and remote planning areas, diverse and extreme environmental conditions, still-evolving hydrocarbon extraction technology, and potential environmental hazards associated with offshore activities.

Since the ESP began more than 40 years ago BOEM has funded nearly $450 million in environmental studies in Alaska, producing more than 1,000 technical reports and peer-reviewed publications. Completed study reports are posted at http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp. An alternate location for browsing Alaska Region study reports by year is http://www.boem.gov/AKpubs. Although much relevant information exists for certain Alaska OCS planning areas, data are sparse in other areas, and environmental and other conditions are changing over time.

In 2012, BOEM released the Proposed Final OCS Oil & Gas Leasing Program 2012-2017 (BOEM 2012), which schedules three potential lease sales in the Alaska OCS. These potential lease sales are deliberately scheduled late in the program to allow for further development of scientific information regarding the sensitive habitats, unique conditions and important other uses, including subsistence hunting and fishing, as well as the oil and gas resource potential in these areas. The first potential lease sale is scheduled for 2016 in the Chukchi Sea Planning Area (Figure 3.2). The Proposed Final Program includes a pre-existing 25-mile nearshore buffer and an additional deferral area to the north of Barrow that will not be considered for leasing due to its documented importance for subsistence use. Another lease sale is proposed for 2017 in the Beaufort Sea Planning Area (Figure 3.3). Two subsistence whaling areas near Barrow and Kaktovik will be excluded from this lease sale. Also, the Proposed Final Program includes a lease sale in the Cook Inlet Planning Area (Figure 3.4) in 2016. BOEM has determined that the scope of potential industry interest is sufficient to warrant completion of a full environmental impact statement prior to making a final decision about the Cook Inlet lease sale.

BOEM approved Shell Offshore, Inc.'s Beaufort Sea Exploration Plan (EP), subject to conditions in 2011. Shell Offshore plans to drill up to four exploration wells in the Beaufort Sea over multiple years. During 2012, Shell Offshore completed the top hole section of one well at its Sivulliq Prospect in the Beaufort Sea but encountered problems towing its drill rig out of Alaska in December of that year and has not resumed drilling. While Shell Offshore remains interested in continuing exploration work in the Beaufort Sea, it has decided to prioritize Chukchi Sea exploration and will concentrate its efforts entirely in the Chukchi Sea during the next few years.

In 2014, Shell Gulf of Mexico, Inc. (Shell GOM) submitted a Revised Chukchi Sea Exploration Plan (EP Revision 2) to BOEM for approval. The company's goal is to drill up to six wells at its Burger Prospect, located about 85 miles northwest of the coastal village of Wainwright, in waters

approximately 140 feet deep. Shell GOM proposes to conduct drilling operations during the open water season (generally July 1-October 31) each year until all six drill sites are drilled. Shell GOM states that its predicted "average" drilling season, constrained by prevailing ice conditions and regulatory restrictions, is long enough for a drilling rig to drill an exploration well from spud to proposed total depth and possibly construct an additional well cellar or drill and secure a partial well. Shell GOM's proposal is a continuation of exploration drilling that began in 2012, when it completed the top hole section of one well at Burger. The company was unable to resume work in 2013 because of problems with its drill rig, and in 2014 it halted its planned exploration of the Chukchi Sea because of the January 2014 remand of Lease Sale 193 by the U.S. Court of Appeals for the Ninth Circuit. In response to the Lease Sale 193 remand, BOEM prepared a Second Supplemental Environmental Impact Statement and a subsequent Record of Decision, which affirmed Lease Sale 193. In March 2015, Shell GOM submitted an updated version of their Exploration Plan (EP) Revision 2.

The Liberty prospect is located in the central Beaufort Sea about 7 miles east of the existing Endicott Satellite Drilling Island (SDI), and BP Exploration Alaska, Inc. (BPXA) and Hilcorp Alaska, LLC (HAK) hold joint interest in Liberty.   HAK, as unit operator, submitted a development and production plan (DPP) to BOEM in 2014. The DPP proposes construction of a man-made gravel drilling and processing island with a pipeline to shore, tying into the Badami Pipeline. HAK has estimated that the reserves for the Liberty project are between 80 and 150 million bbls of oil, and peak production could range between 60,000 and 70,000 bbls of oil per day.

Northstar is a joint Federal/State of Alaska production unit located in the Beaufort Sea about 12 miles northwest of Prudhoe Bay. The six producing Federal wells fall under BSEE regulatory authority, whereas the State wells fall under the Alaska Oil and Gas Conservation Commission regulatory authority. Production started in 2001 and peaked in 2004. Total production of crude oil through February 2015 is over 163 million bbls, with the Federal portion comprising approximately 29.2 million bbls.
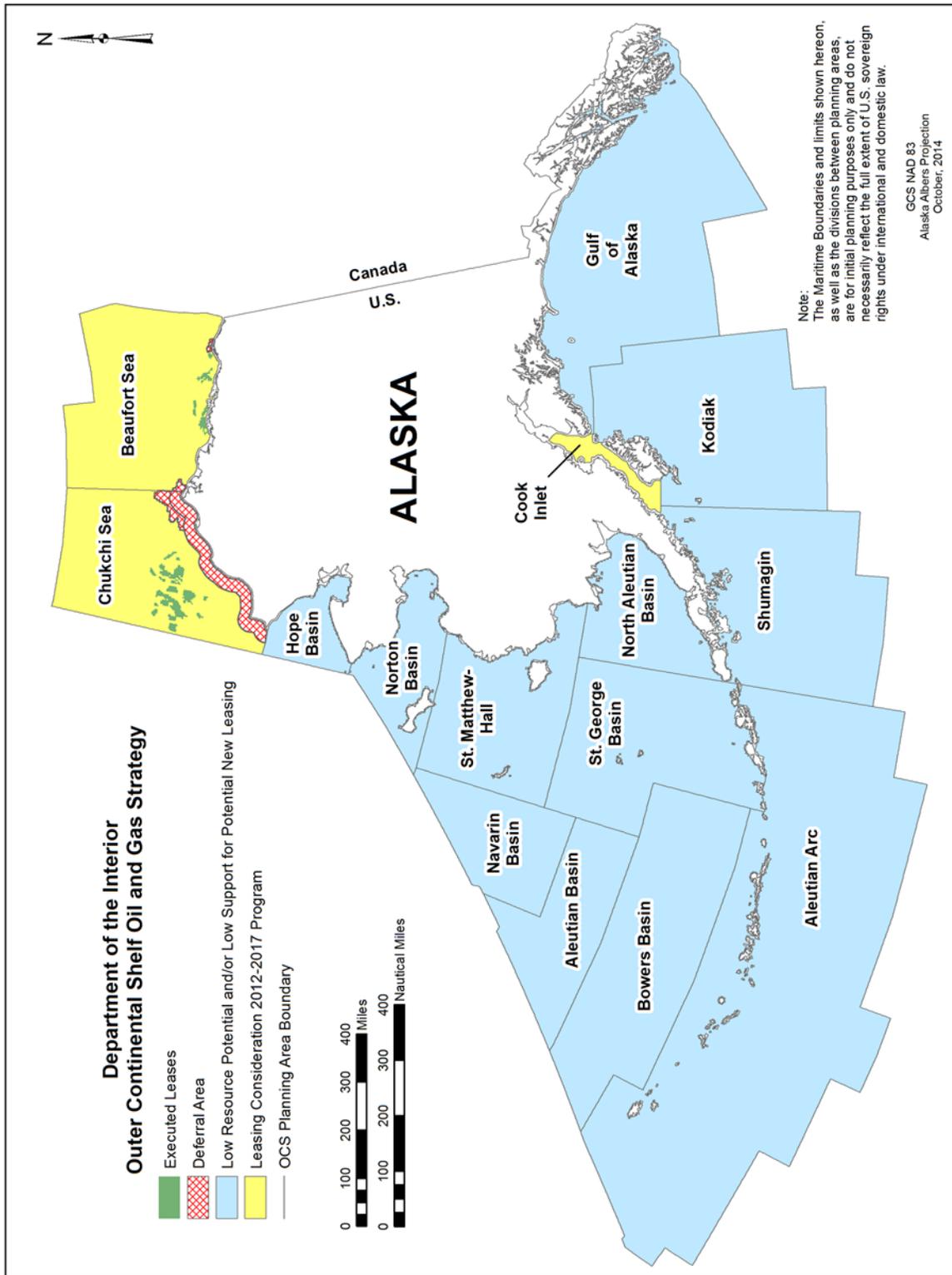
**Figure 3.1.** Alaska OCS Region Planning Areas
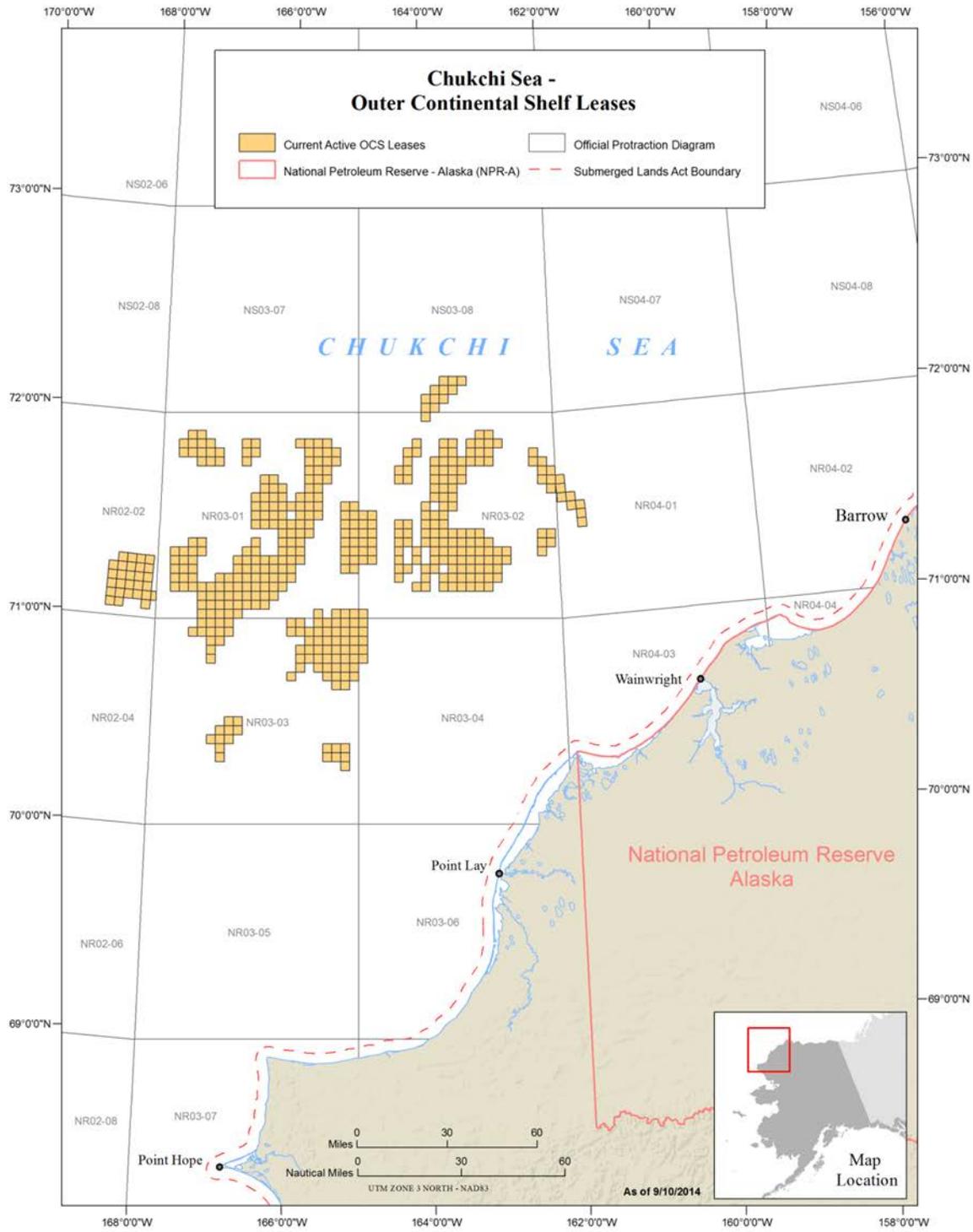
Figure 3.2. Chukchi Sea Oil and Gas Leases
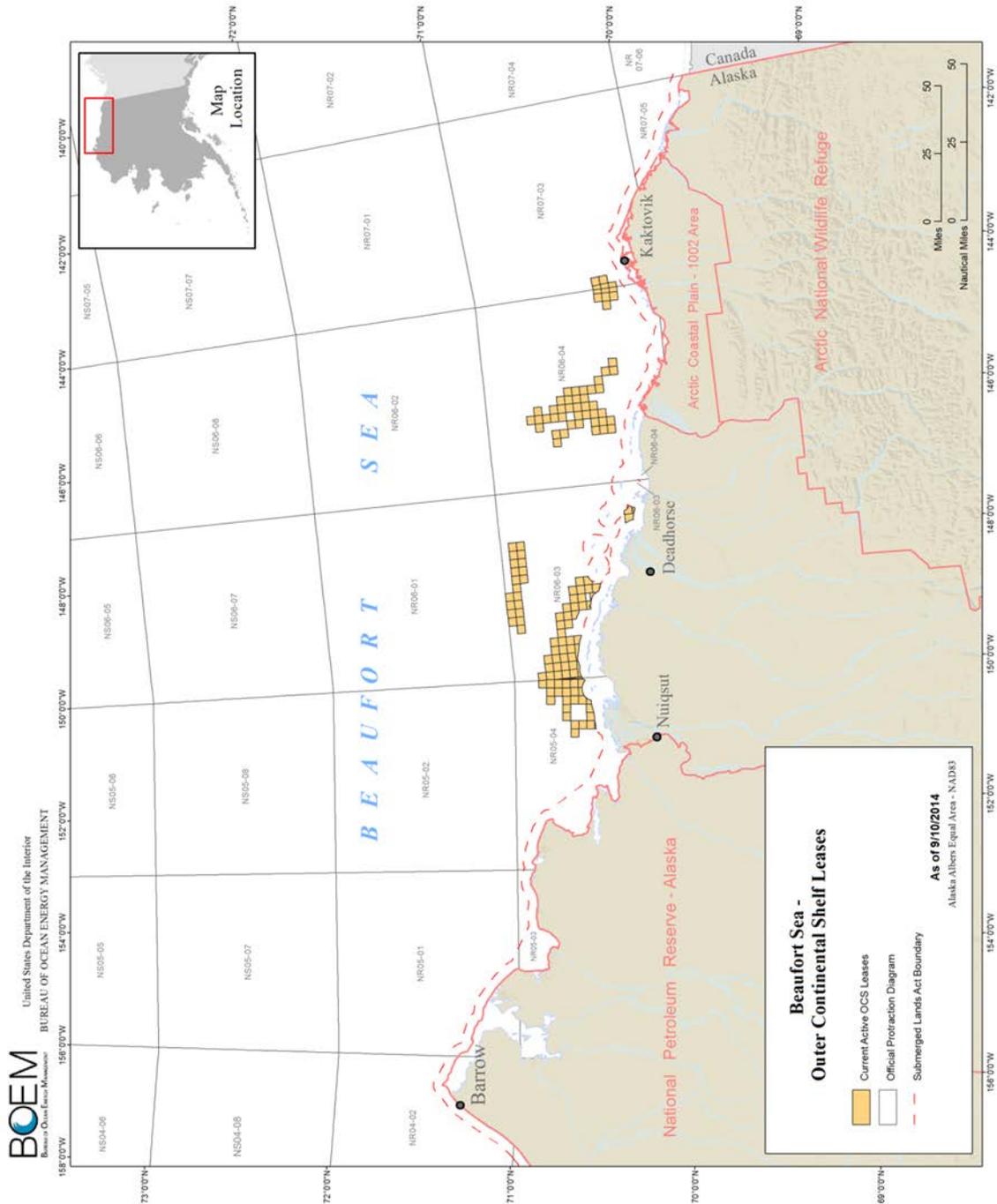
Figure 3.3. Beaufort Sea Oil and Gas Leases
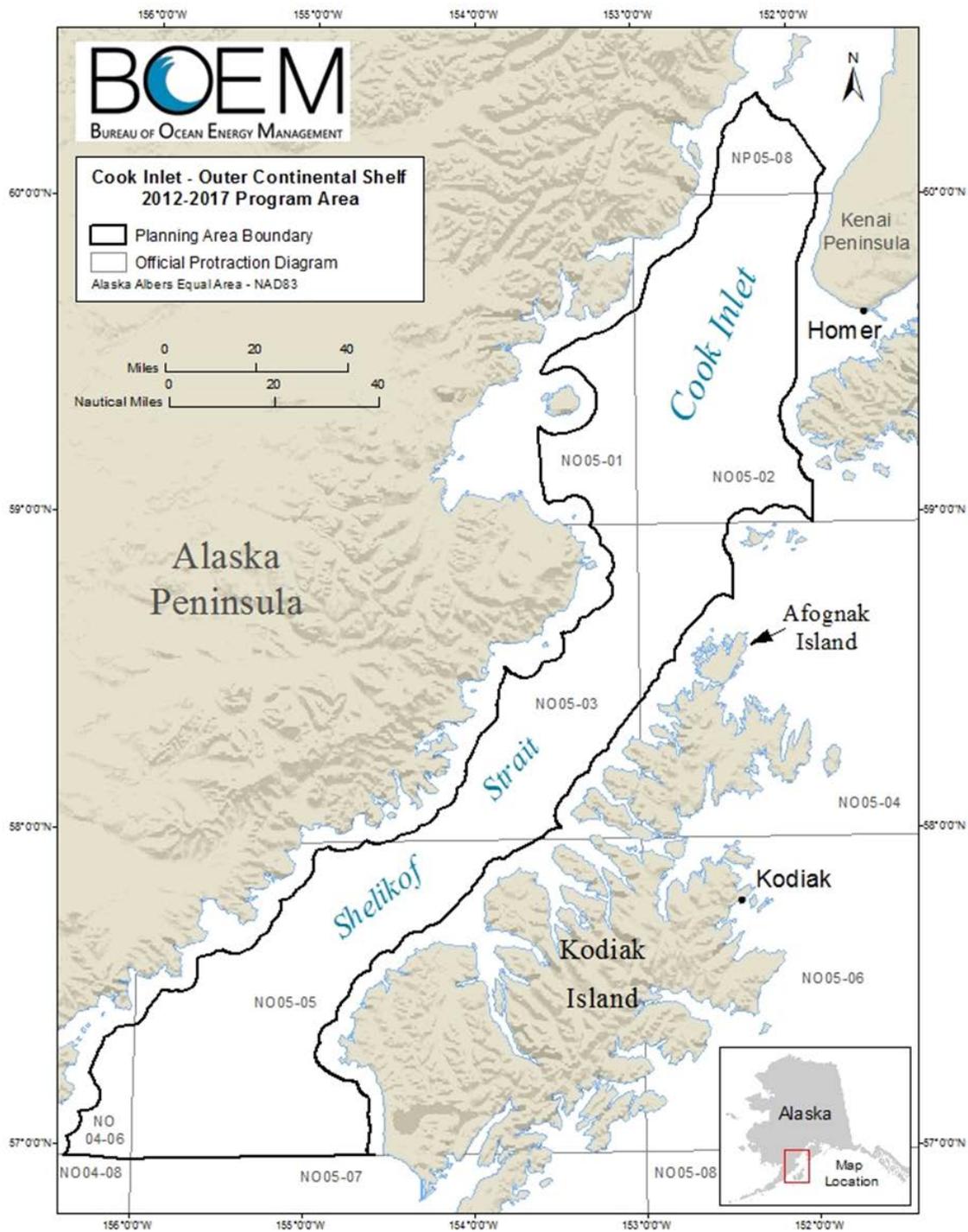
Figure 3.4. Cook Inlet Planning Area

Climate change is accelerating in the Arctic, leading to a rare but true baseline environmental change. In recent years, the extent of summer ice cover is decreasing more rapidly than was predicted by most global change models. The extent, duration, and thickness of summer ice cover in the Arctic region have decreased to record historical lows. The loss of ice cover is causing changes to both physical oceanography and ecosystem productivity and has significant ramifications for marine mammals, bird and fish species that live on, below, or near the ice.

Climate change also entrains many socio-economic issues. Some immediate concerns include: increased shoreline erosion and permafrost melt that threatens arctic villages and infrastructure; changes in distribution and availability of hunted subsistence species; and potential changes in commercial and subsistence fisheries as commercial species such as salmon move north. In consideration of such basic transition, scientists are challenged to project how climate change effects will interact with OCS activities in the Arctic over the next 25-50 years.

Section 388 of the EPAct amended the OCSLA to give discretionary authority to BOEM to issue leases, easements or rights-of-way on the OCS for alternative energy projects, such as wind, wave, or ocean current facilities. Under this authority, the areas that BOEM makes available for alternative energy leasing are likely to be determined through a process that assesses different types of alternative energy resources, anticipated and potential environmental impacts, and other relevant information on a national, regional, or local basis. No lease sales for renewable energy are currently planned for the Alaska OCS. In addition, the OCSLA gives discretionary authority to BOEM to issue leases for mineral resources, but no lease sales for mineral resources are currently planned for the Alaska OCS.

3.2   Conventional Energy Science Strategy

In recent years, BOEM has placed primary emphasis on studying the Beaufort and Chukchi seas, conducting interim baseline research and monitoring in diverse fields of interest. Most of the projects exhibit complex, multilateral collaborations, with explicit inter-disciplinary linkages between the physical and biological sciences. Many of them also provide a role for active participation by Alaska Native residents and input from sources of traditional knowledge.

To support NEPA analyses for the upcoming lease sale in Cook Inlet, BOEM seeks to update information about the physical and biological environment in lower Cook Inlet and Shelikof Strait. Some particular interests for information include, but are not limited to: an improved understanding of circulation and water mass movement in lower Cook Inlet; assessment of variability and long-term trends in oceanographic conditions and biological communities; and changing use of the area by sensitive species among cetaceans, sea otters, pinnipeds, and seabirds.

Air Quality

In December 2011, Congress transferred jurisdiction and authority for the control of air emissions on the OCS in the Beaufort and Chukchi seas from the Environmental Protection Agency (EPA) to BOEM. While implementing this authority, BOEM will need air quality monitoring information to assess the cumulative air quality impact of off-shore Arctic oil and gas activity and to support compliance with the OCSLA and environmental justice initiatives.

The transfer to BOEM of authority to regulate industrial emissions in OCS areas of the Beaufort and Chukchi Seas necessitates increased focus on Arctic OCS air quality considerations. Arctic oil and gas exploration and extraction activities proposed for the OCS require environmental evaluations pursuant to the National Environmental Policy Act, as well as air quality operating approval, to comply with the impact analysis under BOEM's implementation of the OCSLA. Information will be used to assess the cumulative air quality impact of off-shore Arctic oil and gas activity, including oil spill response equipment and associated support equipment not already accounted for through State and Federal air quality requirements. The ongoing study *Arctic Air Quality Impact Assessment Modeling* will compile a dataset of emission sources that will be used to drive EPA-approved air quality models.

BOEM is also implementing new data policy requirements so that significant products produced from BOEM-funded efforts, such as atmospheric models, may be made available for use by the general public and broader scientific research communities. For example, the proposed study *Community Web Access to WRF Atmospheric Model Results and Meteorological Station Data, 1979-2009* will process meteorological observational data from the Chukchi and Beaufort seas and upload them to an online data portal for external use.

Fates and Effects

As interest in Arctic OCS energy development increases, there is also growing concern of possible adverse environmental impacts. North Slope residents are especially concerned about potential contamination of their food supply. In the Beaufort Sea such foods include bowhead whales, seals, waterfowl and fish. Of particular concern are environmental effects of industrial development on this biota, including those from potential oil spills. Up-to-date information on ocean currents and sea ice is necessary to fully address these concerns. Contaminant monitoring in biota and sediments, therefore, is ongoing in both the Beaufort and Chukchi Seas. The *Arctic Tracer Release Experiment* (ARCTREX) is performing targeted dye release experiments at both the surface and bottom of the Northeast Chukchi Sea to examine applications for mapping of spilled oil in Arctic waters. In addition, the recently awarded study *Physical and Chemical Analysis of Crude and Refined Oils: Lab and Mesoscale Oil Weathering* is conducting laboratory and mesoscale oil weathering tests on a number of Alaskan crude or condensate oils, as well as refined oils, to provide information on the fate (weathering) of oil spills in the environment.

Due to the lack of historical data for oil spills on the Arctic OCS, BOEM derives oil-spill rates for oil-spill risk analysis using a fault-tree model. Fault-tree analysis is a method for estimating the spill rate resulting from the interactions of other events. Fault trees are logical structures that describe the causal relationship between the basic system components and events resulting in system failure. Using fault trees, oil-spill data from the Gulf of Mexico and Pacific OCS can be modified and incremented to represent expected Arctic performance based on both Arctic and non-Arctic variability. The proposed study *Updates to the Fault-Tree for Oil Spill Occurrence Estimators* will develop oil-spill occurrence estimates to support NEPA analyses and decision-making for OCS activities in the coming years. Results from the study *Development of an Arctic Trajectory Analysis Planner*, also proposed for FY 16, will provide a tool to facilitate evaluation by BOEM analysts of the threat to a particular site or resource from a potential oil spill within the Pacific Arctic region.

Habitat and Ecology

Fish and benthic organisms in the Beaufort and Chukchi seas fill essential roles in the Arctic ecosystem by consuming small prey and, in turn, providing a food resource for larger fishes, birds, marine mammals, and people. It is important, therefore, to assess the distribution and abundance of fishes in these areas and to distinguish between changes due to anthropogenic and natural effects. In addition, assemblages and populations of fish and benthic organisms in marine ecosystems off Alaska have undergone observable regime-shifts in diversity and abundance over the last 20-30 years.

The Magnuson-Stevens Fishery Conservation and Management Act is the Federal law that governs U.S. marine fisheries management for all OCS waters. Under the Magnuson-Stevens Act, each fishery management plan must describe and identify EFH for the fishery, minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH. BOEM and other Federal agencies must consult with NMFS regarding any action that may adversely affect EFH. BOEM engages in consultation with NMFS officials and EFH assessment related to adult and late juvenile life-stages of a number of species, including Arctic cod, Pacific salmon, and saffron cod.

Several studies will provide information about a range of fish and benthic species and their habitats in the Beaufort and Chukchi Seas, as well as Cook Inlet. BOEM is partnering with industry, NOAA, U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), the University of Alaska Fairbanks (UAF), and others to integrate biological, chemical, and physical information and improve understanding of these complex marine environments and potential impacts from oil and gas development activities. These studies include: the *Arctic Marine Biodiversity Observing Network* (AMBON) in the Chukchi Sea; *Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area*, also known as *Arctic Ecosystem Integrated Survey*; *Ecological Processes in Lower Cook Inlet and Kachemak Bay*; and the *Marine Arctic Ecosystem Study* (MARES).

The study *Arctic Ecosystem Integrated Survey, Phase II*, which is proposed for FY 2016, will extend that project for an additional five years. Also, the study *Updating Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet* will provide updated monitoring information to facilitate comparisons with data collected in the 1990s.

Information Management

Collective scientific knowledge is fundamentally a social enterprise, and advances over time through deliberate efforts to manage and disseminate information in a responsible manner. This ongoing process requires targeted project funding that could take many forms, including: sponsorship of conferences and workshops, support for synthesis reports and inter-project data mining, archival organization of data and collected voucher specimens, and occasional pilot projects to improve field methods and equipment. For example, BOEM now intends to partner with the North Pacific Research Board (NPRB) on new collaborative research in the Arctic, leveraging expertise across several partners and funding sources through the proposed *Collaboration with North Pacific Research Board (NPRB) Arctic Marine Research Program.*

Expenses associated with outreach and public service activities are also funded and justified under the broad goals of information management.

Marine Mammals and Protected Species

BOEM also has a substantial research focus on marine mammals and other protected species on the Arctic OCS and in Cook Inlet. The Iñupiat rely heavily on bowhead whales for subsistence. The bowhead whale is central to Alaska Native cultural and spiritual life. Whale hunters have reported that migrating bowhead whales deflect from their normal migratory route well upstream of active industry vessels and may divert a great distance from their migration route. A concern is that deflection around oil and gas activity (including seismic surveys, drilling activity and associated icebreaker support) makes whales skittish and more difficult to hunt. Information about bowhead feeding and habitat use is also needed, and it is important to assess the factors that may be affecting the habitat use, health, population status, and migration routes of bowhead whales. Noise from industrial activity is a central concern. Additionally, Iñupiat whale hunters as well as the scientific community have raised concerns about potential cumulative impacts on bowhead whales.

The populations of bowhead whales, polar bears, spectacled eiders, spotted and ringed seals, and other threatened and endangered species, as well as candidate species such as walruses and some ice seals, are an ongoing concern. Potential effects from loss of sea ice are a particular concern. More comprehensive abundance estimates for these ice-associated marine mammals enhance the assessment of potential impacts under NEPA and to ensure compliance with Federal management and regulatory mandates for marine mammals under the MMPA. North Slope residents are also concerned about potential disturbance of beluga whales, ringed seals, waterfowl and other subsistence-wildlife species by oil and gas activities such as helicopter overflights. Multiple studies are currently ongoing to address these concerns, including: *Distribution and Relative Abundance of Marine Mammals in the Chukchi Sea and the Fall Migration of Bowhead Whales in the Beaufort Sea*, also known as the *Aerial Survey of Arctic Marine Mammals*; and *Walrus Seasonal Distribution and Habitat Use in the Eastern Chukchi Sea*.

BOEM plans to continue the *Aerial Survey of Arctic Marine Mammals* in the Beaufort and Chukchi Seas, and to research the abundance of marine mammals in Cook Inlet through the study *Marine Mammal Distribution, Abundance, and Ecology in Cook Inlet*. In addition, the study *Estimation of Abundance and Demographic Rates of Pacific Walruses Using a Genetics-based Mark-Recapture Approach* is proposed for FY 2016 in collaboration with USGS.

Physical Oceanography

Accurate information on surface wind fields, ocean currents, and sea ice is also important for determining the fate of spilled oil and the potential impacts on biota associated with these systems. Studies conducted by the Alaska OCS Region have demonstrated that water motion is very different under landfast ice than in adjoining open sea or pack-ice areas. It therefore becomes important to know locations and seasonal changes in the distribution of polynyas, leads, and landfast ice. Information about ice gouge characteristics and recurrence rates is also needed

to assess risks associated with burial of oil production pipelines to support BOEM's fault tree modeling.

In the ongoing study *Characterization of Circulation in the Northeast Chukchi and Western Beaufort Sea* ocean current circulation fields are mapped and analyzed along the coast of the northeastern Chukchi and western Beaufort seas through the deployment of coastal High Frequency radar systems, offshore bottom mounted Acoustic Doppler Current Profilers (ADCPs), gliders and surface drifters. Additionally, BOEM is working to obtain a better understanding of the motion and behavior of ice through development of satellite-tracked ice drifters, as well as improved ocean circulation modeling capabilities. The proposed study *Synthesis and Evaluation of Sub-Seabed Physical Environmental Data for the Beaufort and Chukchi Seas* will provide information to improve regional understanding of current geological processes (sedimentation, benthic habitats, ice gouging, strudel scour, faulting, shallow gas, etc.), soil engineering properties, permafrost and methane hydrate distribution, oil seeps, archeological resource potential of the Beaufort and Chukchi shelf areas.

Social and Economic Sciences

BOEM is also addressing concerns regarding the impacts that Alaska OCS development may have on local communities and economies. The Iñupiat report in public testimony that their culture is vulnerable to short-term, long-term, and cumulative effects from OCS activities, and they are concerned that OCS activities might lead to:

- Social disruption and a change in cultural values through population shifts, especially immigration of large numbers of non-Iñupiat to the North Slope

- Employment changes (potential effects on subsistence way of life by a cash economy, and its continued expansion or contraction)

- Cumulative effects of multiple industrial activities, alteration of subsistence-harvest patterns, and displacement of hunters and subsistence resources

There is an ongoing need to monitor key indicators of socioeconomic and cultural changes on the North Slope. The Iñupiat rely on a wide variety of marine resources as significant sources of food. In addition, the harvesting, sharing and consuming of subsistence resources form an important part of the traditional Iñupiaq culture and spiritual life. People are concerned that a temporary or permanent elimination of primary subsistence foods would cause North Slope residents either to shift to less desired subsistence resources or to replace subsistence foods with expensive western foods. The Iñupiat are concerned about mitigation of impacts and compensation for potential losses. An anticipated decline in oil revenues to the North Slope Borough (NSB) is also an issue of concern. Through the study *Social Indicators in Coastal Alaska*, BOEM is working to update key socio-cultural and economic baseline data for analysis of potential local and regional impacts from offshore exploration and development activities. BOEM also participates in the multi-agency research effort known as Arctic Science, Engineering, and Education for Sustainability (ArcSEES), which assesses the interactions between humans and the environment in Arctic regions.

Another concern is the use of local and traditional knowledge in analysis of potential environmental effects. We continue to seek and include firsthand knowledge of local subsistence hunters to enhance the scientific knowledge base. In an effort to capture and document such observational data, BOEM plans to support the Local Environmental Observer (LEO) network, which was established by the Alaska Native Tribal Health Consortium, Center for Climate and Health through the proposed project entitled *Community Based Monitoring: LEO Network.*

The archaeological significance of offshore areas has been recognized in recent years, and marine archaeological studies have been showing the presence of prehistoric sites on the shelves beneath the modern ocean. Basic information and analysis is needed for assessments of archaeology potential in the Beaufort and Chukchi seas to support the National Historic Preservation Act (NHPA) and NEPA review. Data are very limited in the Chukchi Sea, and the last baseline study in the Beaufort Sea is decades old. The proposed study *Synthesis and Evaluation of Sub-Seabed Physical Environmental Data for the Beaufort and Chukchi Seas* will help to address these information needs.

Interdisciplinary

The Alaska OCS Region has a long history of supporting multidisciplinary research, beginning with the *Outer Continental Shelf Environmental Assessment Program* (OCSEAP) surveys conducted between the 1970s and early 1990s and the *Beaufort Sea Monitoring Program* (BSMP) in the 1980s. The *Arctic Nearshore Impact Monitoring in Development Area* (ANIMIDA) program and its continuation (cANIMIDA) started in 1999 to provide baseline data and monitoring results for chemical contamination, turbidity, and subsistence whaling in the vicinity of Northstar and Liberty development sites. This work continues today with the *ANIMIDA III* studies, and the study area has been expanded to include Camden Bay.

The *Hanna Shoal Ecosystem Study* is documenting the circulation and density fields, as well as ice conditions, at Hanna Shoal and examining important chemical, physical and biological interactions with the unique ecological regime in this highly productive area. BOEM is also partnering with NMFS and NOAA's Pacific Marine Environmental Laboratory to conduct the *Arctic Whale Ecology Study* (ARCWEST) and the *Chukchi Acoustic, Oceanography and Zooplankton Study (CHAOZ): Hanna Shoal* to assess the importance of the highly productive Hanna Shoal with respect to a range of mammal species. The BOEM study *U.S.-Canada Transboundary Fish and Lower Trophic Communities,* conducted by UAF in collaboration with the Department of Fisheries and Oceans Canada, is documenting baseline fish and invertebrate species presence, abundance, distribution and biomass in the U.S. and Canadian Beaufort Sea. This study will also integrate information on the hydrographic structure of the eastern Beaufort shelf to provide enhanced understanding of the effects of habitat variables such as temperature and salinity on species distributions under different climate conditions.

In addition to the ongoing need for integrated research programs, there is also a need for synthesis of results from multiple studies to facilitate interpretation of data across disciplines. The ongoing *Synthesis of Arctic Research* (SOAR) study brings together a multidisciplinary group of Arctic scientists and Alaskan coastal community representatives to explore and integrate information from completed and ongoing marine research in the northern Bering, Chukchi and Beaufort seas. Many of the studies proposed for FY 16 identified above also take

an integrated approach to examining the interdependence of physical, biological and social processes, and filling identified information needs across the various disciplines.

Tables of proposed studies for the Alaska Region are included in Appendix I. Profiles for these proposed studies are provided in Appendix II.

3.3 Future Plans

3.3.1 Conventional Energy Future Plans

Fates and Effects

The Alaska Region has been collecting baseline biological and chemical monitoring data in the Beaufort Sea since the 1980s, first under the BSMP and more recently through the suite of ANIMIDA studies. Similar monitoring work has also been ongoing in the Chukchi Sea since 2008, through the Chukchi Offshore Monitoring in the Drilling Area: Chemistry and Benthos (COMIDA-CAB) study and the Hanna Shoal Ecosystem Study. The need for additional monitoring will continue to be re-evaluated as oil and gas development in the Alaska Region OCS evolves.

Available information concerning the input of hydrocarbons into the environment through natural oil seeps in the Beaufort and Chukchi seas is quite limited. Identification of the location and extent of these seeps, as well as information on the chemical composition and weathering characteristics of these oils, would provide additional insight for analysis of potential effects from oil spills. Additionally, the presence of natural oil seeps is indicative of organisms adapted to metabolize the hydrocarbons. More information, therefore, is needed about hydrocarbon-consuming organisms that reside in the Arctic.

Habitat and Ecology

BOEM needs information to assess and manage the potential environmental effects of offshore development on marine fish. More detailed information about the biology and ecology of many marine fish species inhabiting the existing and future Alaska leased areas would be especially useful. The highest priority BOEM information needs include species presence, distribution, abundance and potential effects of oil spills, particularly during periods when ice is present. As offshore oil development interest expands to deeper and more widespread areas, additional fisheries information is required.

As a result of the Magnuson-Stevens Fishery Conservation and Management Act, effects on Essential Fish Habitat must be evaluated. In the Bering and Chukchi Seas, more information is needed to evaluate Essential Fish Habitats in the Chukchi Sea as commercial fish species move northward from the Bering Sea. Beaufort Sea waters are also considered Essential Fish Habitat for salmon, and future research on salmonid reproduction in Beaufort Sea drainages is indicated to clarify environmental assessment and mitigation needs.

Seismic exploration and its effects on fish is a high-priority issue for Arctic residents. More information regarding the effects of seismic exploration on the health, behavior, distribution, and

migration of the numerous important fish species of the Beaufort and Chukchi seas would be valuable for NEPA analyses.

Alaska Natives are concerned that OCS activities will affect subsistence fish populations and reduce availability for subsistence harvest. Consequently, additional research on arctic fisheries and recruitment to nearshore feeding populations are an important consideration. Several fish species used for subsistence migrate through, or are found in, the Northstar and Liberty areas of the Beaufort Sea, including arctic and least cisco, Dolly Varden, arctic char, and humpback and broad whitefish. Intermittent occurrences of pink and chum salmon also take place in Beaufort coastal waters.

A need for more information on the forage fish resources and their relation to apex predators in the Bering, Chukchi and Beaufort seas is also indicated. A good understanding of the seasonal distribution, abundance and habitat use of forage fish, including key spawning and migration events that quickly transfer large amounts of energy to upper trophic levels, is fundamentally important to monitoring the potential environmental impacts associated with offshore development.

Marine Mammals and Protected Species

Oil and gas-related activities, including production at the Northstar site and other potential sites, may lead to risks of oil spills from buried pipelines, other discharges, noise from various industrial and support activities, and increased human interaction with arctic offshore species. Species protected under the ESA, MMPA, and the Migratory Bird Treaty Act are of particular concern if impacted by such factors. Study of the effects of oil and gas-related activities on protected mammals and the need for monitoring of endangered species are expected to continue. Related to this is the need for assessment of how any changes in the bowhead whale migration's distance from shore could relate to subsistence success (see below). Future bowhead whale studies are expected to continue to explore use of satellite tagging for information on bowhead whale residence times in development areas. BOEM anticipates pursuit of new opportunities to obtain and update information on bowhead behavior in response to industrial noise through the use of appropriate research partnerships.

Effects of construction activities on polar bears, especially on denning bears, and concerns about the adequacy of information about all age/sex categories of the bear population will need to be addressed by additional research. Several ongoing studies are expected to lead to recommendations for additional information regarding polar bears and continued study of the polar bear population's vulnerability to oil spills through improved models.

Other key subsistence species potentially exposed to short-term or cumulative impact factors for which behavioral or monitoring studies may be needed include beluga whales, walrus, ringed seals, ribbon seals and bearded seals.

Physical Oceanography

An ongoing challenge in the Alaska OCS Region is the need for better, finer scale circulation and oil-spill models and higher resolution data. This need is underscored by the rapidly

changing conditions in the Arctic. Continued development and application of state-of the-art circulation models is important for future OSRA-based EIS analyses. Improvements are also needed in sea ice aspects of the modeling. The resolution of ice models and ice data needs to be increased to address the propagation of fine scale non-random interactions across hundreds of miles of pack ice in the case of ice leads, as evidenced by recent improvements in satellite oceanography.

A better understanding of the first order physics controlling regional circulation and ice conditions within the U.S. Beaufort and Chukchi seas, as well as interactions with the Arctic basin and Canadian Beaufort, would inform and improve regional analyses for EISs, EAs, and oil-spill response planning documents. In particular, more information is needed to assess the impact of ice on the nature and amplitude of the upwelling/downwelling and to gain a better understanding of the dynamics associated with river outflow plumes, especially under ice.

Social and Economic Sciences

Residents of the coastal communities in both the North Slope Borough (NSB) and the Northwest Arctic Borough (NWAB) frequently express concern about cumulative impacts of offshore and onshore developments on their subsistence way of life. Some of the concerns of the Iñupiat include diminished access to hunting and fishing areas around oil industry infrastructure, reduced harvests, increased hunter efforts, increased hunter cost and general food security. How, and to what degree, subsistence activities have been affected by industry infrastructure and industry activity is a concern that will continue to be further addressed by additional research. Consideration of cumulative impacts is an important issue for BOEM in preparing NEPA documents.

Aggregate effects research also encompasses a broader set of issues concerning how the Iñupiat society has been potentially affected. Relevant issues include a wide range of topics, such as the changing relationship between the cash economy and household subsistence activities, changing sources of anxiety and stress at multiple levels of organization, potential changes in sharing of subsistence resources and in the recruitment of youth into subsistence activities. Social indicators should be maintained to serve as a basis for estimating long-term community impacts.

CHAPTER 4 GULF OF MEXICO STUDIES

4.1 Introduction

Ongoing activities in the GOM consist of conventional oil and gas as well as non-energy marine mineral leasing of sediment resources to support coastal restoration projects. At this time, no development of renewable energy resources is underway in the GOM Region (GOMR). The GOMR is the most active U.S. OCS area: there are currently more than 5,600 active oil and gas leases in the GOM and more than 2,600 active platforms making significant contributions to the Nation's energy supply. The GOMR currently provides approximately 25 percent of U.S. domestic oil production and 11 percent of U.S. domestic gas production.   Energy exploration and production activities include leasing, exploration, development, removal of platforms, and installation of pipelines The 2012-2017 five-year program proposes 12 lease sales in the GOM. The Central Planning Area, Western Planning Area, and a portion of the Eastern Planning Area not under Congressional moratorium will continue to be considered for potential leasing before 2017 (Figure 4.1). For more information on the GOMR please visit http://www.boem.gov/Gulf-of-Mexico-Region/.

The environmental studies in the GOMR address issues from pre-lease through post-lease operations for conventional energy as well as marine minerals extraction from the OCS. BOEM acquires the scientific information needed for decision making through contracted studies as well as through development of partnerships and fund leveraging. In 1992, the former Minerals Management Service (MMS), now BOEM, entered into a partnership with the Louisiana State University (LSU) to establish the first Coastal Marine Institute (CMI). This partnership, which continues today between BOEM and LSU, was developed as part of an initiative to cultivate new State-Federal cooperative agreements on environmental and socioeconomic issues of mutual concern. These projects are designed to help answer questions regarding the potential impacts from oil and gas and marine minerals activities.

A unique partnership between BOEM and the USGS initiated in 1996 provided new opportunities for partnership in biological research. The USGS, through their Ecosystems Mission Area, has procured and conducted several studies for the GOMR in the past. Studies currently funded by USGS for the GOMR through this partnership include assessments of deepwater corals and land loss in relation to Louisiana's coastal habitat loss.

In 2010, BOEM joined the Gulf Coast Cooperative Ecosystem Studies Unit (GCCESU) as a Federal partner. Membership in the GCCESU creates additional opportunities for interdisciplinary and multi-agency research, technical assistance, and education through collaborations within a network of member Federal and State agencies, universities, and research and environmental groups.

In April 2010, the *Deepwater Horizon* (DWH) incident caused a massive oil spill that released millions of gallons of crude oil into the GOM. The degree and extent of offshore and onshore environmental impacts to natural and cultural resources as well as socioeconomic impacts from this spill are still under investigation. The National Academy of Sciences (NAS) established a research grant program to study environmental science and human health impacts in the wake of the oil spill in the GOM. BOEM staff is involved in coordinating with NAS and other funding

sources, including the Resources and Ecosystems Sustainability, Tourist Opportunity and Revived Economics of the Gulf States Act of 2011 (RESTORE Act), for future projects occurring over the next 30 years.
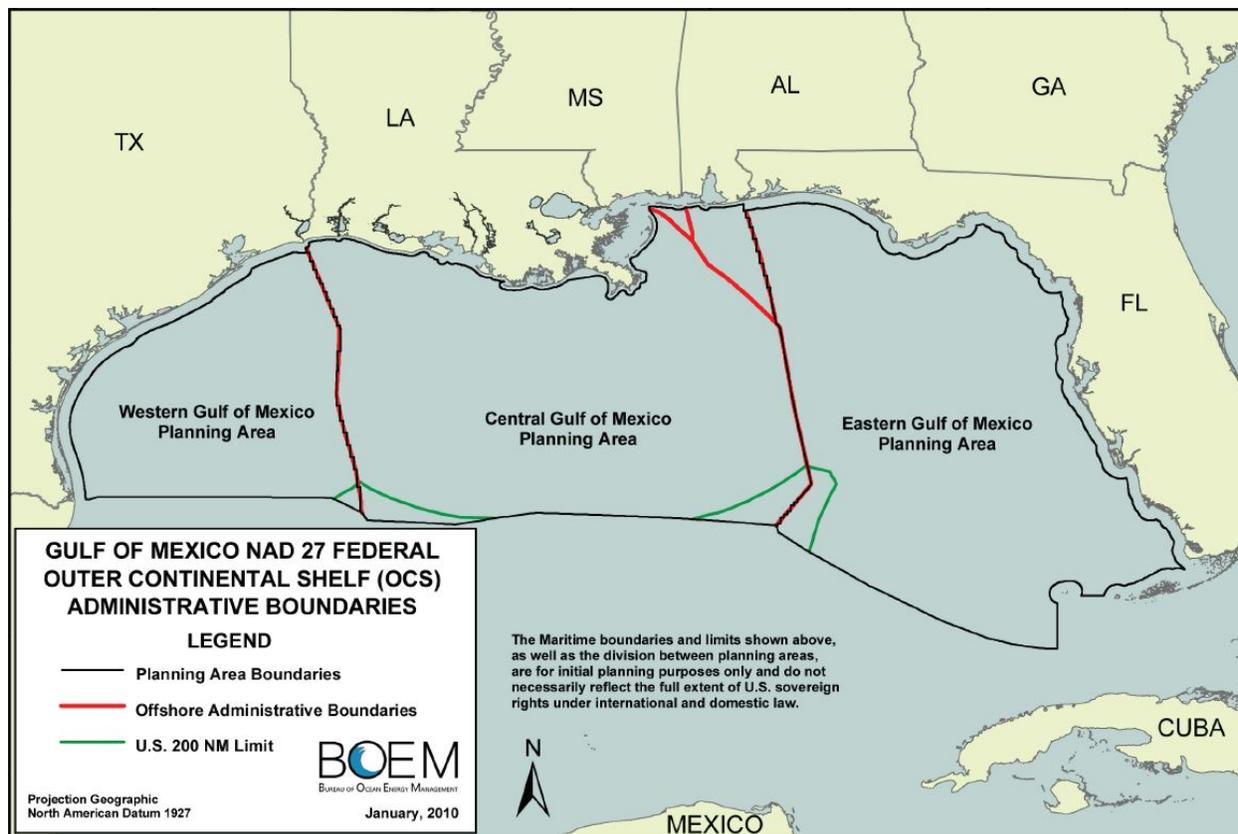
Figure 4.1. Gulf of Mexico OCS Planning Areas.

In addition to conventional energy, the BOEM Gulf of Mexico OCS Region conducts leasing for non-energy marine minerals primarily for coastal habitat restoration. Within the GOM, more than 200 square miles of Louisiana coastal land was converted to open water habitat as a consequence of Hurricane Katrina and other named storms that followed (Figure 4.2). Sand resources needed to repair the damaged coastlines and barrier islands within Alabama, Mississippi, Louisiana, and Texas alone are estimated to be from 250 to more than 300 million cubic yards.

In addition to addressing sand resource needs as a result of hurricanes, the MMP is actively leasing OCS sediment for GOM restoration projects proposed to repair natural resources damaged during the *Deepwater Horizon* oil spill. Projects currently under construction in the GOM include Caminada Headland Beach and Dune Restoration Project and Cameron Parish Shoreline Restoration Project. More than 10 million cubic yards of material has been authorized to be dredged from the OCS for these two projects. These projects are part of the overall Federal effort to work with Gulf Coast communities to help rebuild coastal marshes and barrier islands,

restore damaged beaches, and conserve sensitive areas for wildlife while enhancing the natural protection the landforms provide from storms. In addition, major
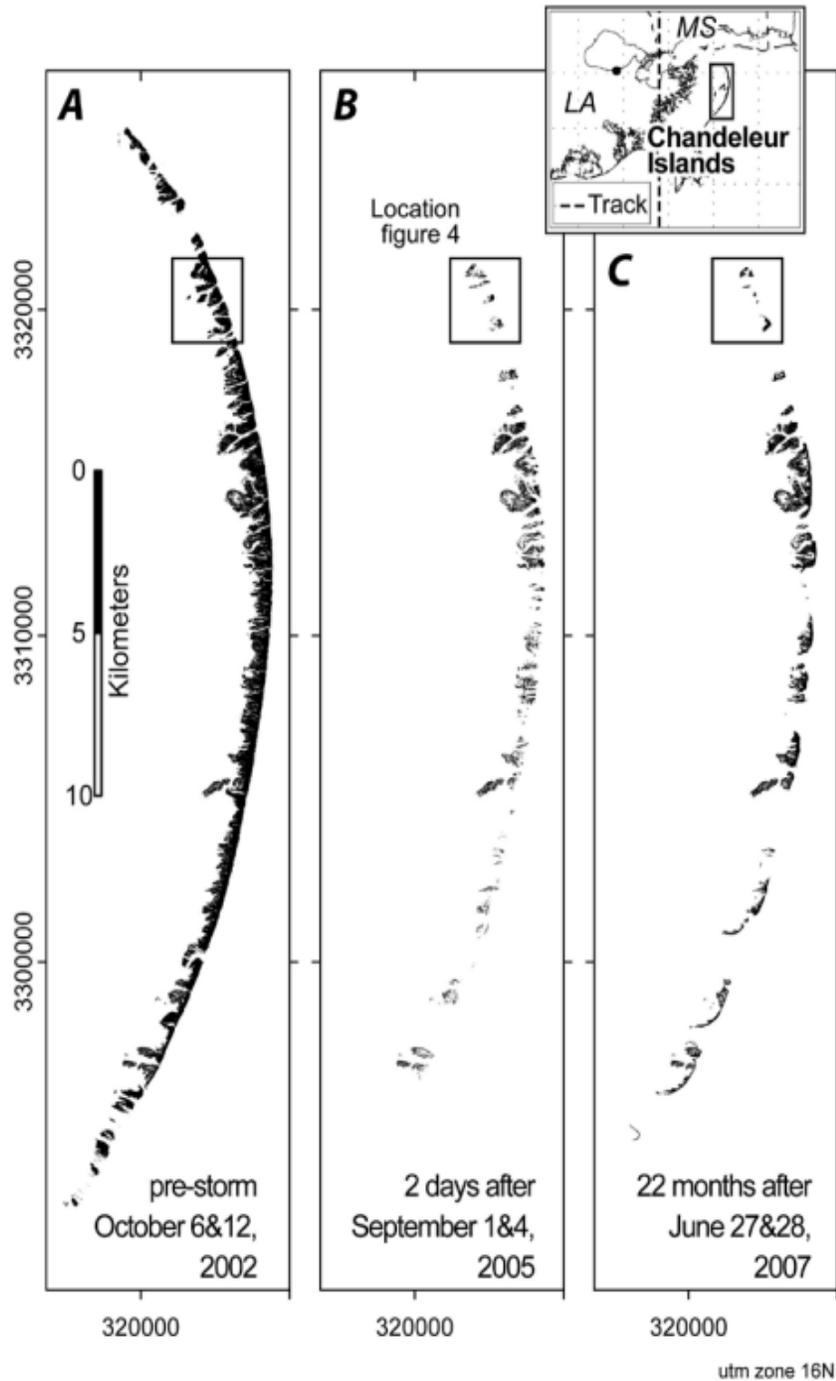
Figure 4.2. Chandeleur Islands on the eastern flank of Louisiana from before and after Hurricane Katrina in August 2005 (Sallenger et al. 2009).

restoration efforts, including the RESTORE Act and Natural Resource Damage Assessment (NRDA), are requiring the use of OCS sand resources to restore coastal wetlands and barrier islands along the fragile Gulf Coast.
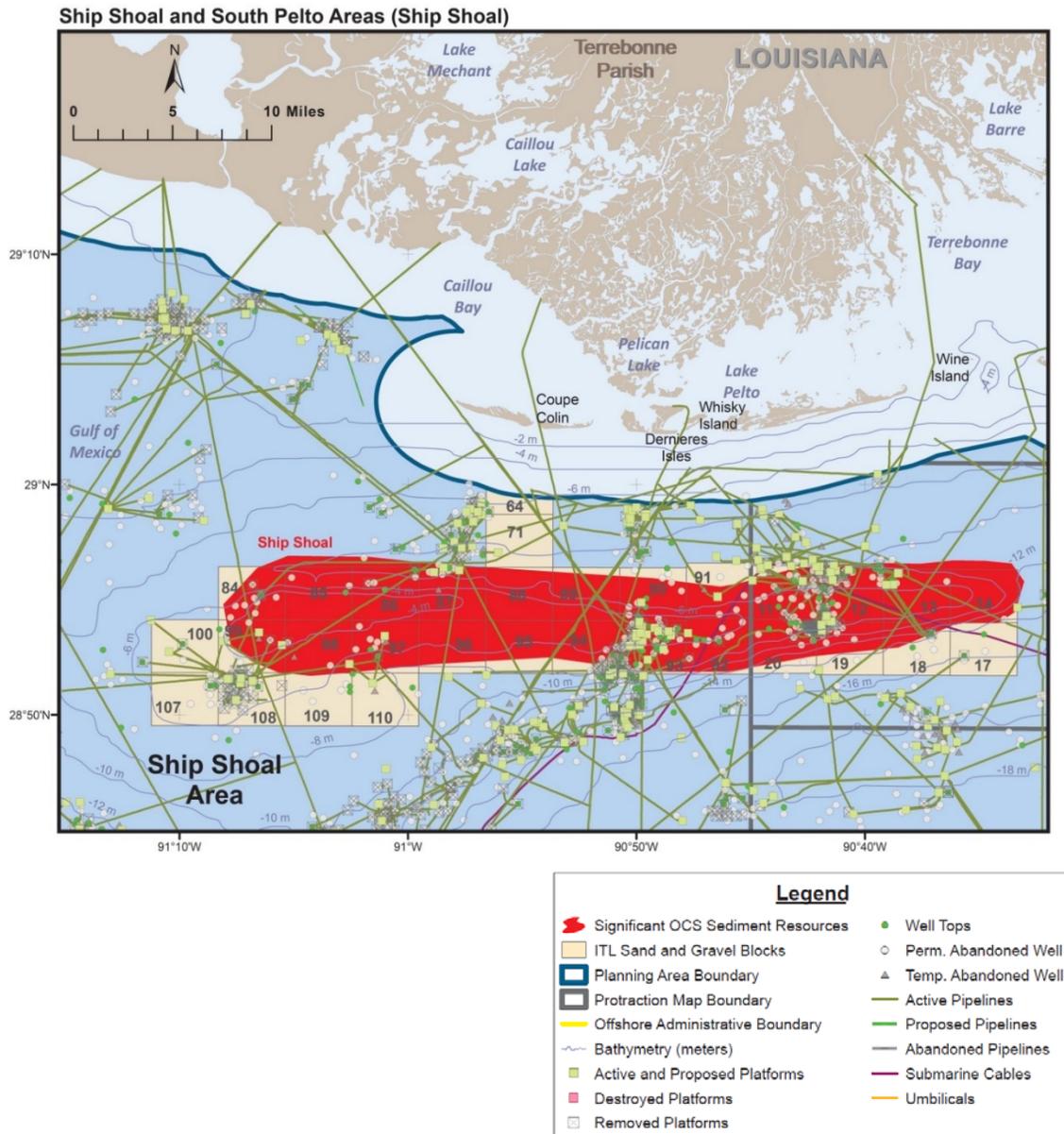
Figure 4.3. Complex Competing Use Challenges With Respect to Oil and Gas Platforms and Pipelines in the Gulf of Mexico.

In the Gulf, complex competing use challenges may result from sand resource areas that may also be optimum sites for oil and gas platforms and associated pipelines. In the GOM, these circumstances, and access and potential environmental resource conflicts are becoming more

complex and deserving of rigorous and integrated environmental study, monitoring, and management (Figure 4.3).

4.2 Conventional Energy Science Strategy

With the extent of offshore oil and gas activities in the deepwater GOM and the DWH oil spill in 2010, environmental and socioeconomic information needs have increased. The GOMR has approximately 55 ongoing studies divided among all areas of interest. Long-term monitoring studies of the cumulative impacts of oil and gas development as well as multidisciplinary studies to understand the effects of and analyze ecosystem recovery from the DWH spill are of particular importance in the GOMR for current and future information needs. Current study needs include assessing the effectiveness of existing mitigation measures and inventories of emissions and hydrocarbon input in the marine environment. In addition, the GOMR recognizes the importance and need to study impacts of conventional energy exploration and development on the human environment through social and economic studies. Lastly, BOEM seeks to obtain a better understanding of the nature and extent of cultural resources as well as to improve current methodologies prescribed by BOEM to identify such sensitive resources.

The proposed studies on the following topics will fulfill the GOMR's information needs to aid in future analysis within EIS's, EA's, mitigations, and other requirements from the NEPA and other environmental laws.

Air Quality

BOEM has several upcoming, ongoing, or recently completed air quality studies to determine impacts of offshore OCS sources on air quality in the GOM onshore coastal areas. One such study is focused on dispersion and photochemical modeling related to air quality in order to assess potential pre- and post-lease impacts to the states, as required under OCSLA. The modeling results will be used by BOEM post-lease in support of the Bureau's need to update the air quality regulations for the exemption level threshold analysis found at 30 CFR 550 Subpart C and pre-lease in the National Environmental Policy Act Environmental Impact Statement cumulative analysis to support compliance with OCSLA.

The operators completed collecting activity data for the Year 2014 Gulfwide Emissions Inventory Study, GOADS-2014, which is due to BOEM in April 2015. This activity data will be used to calculate OCS platform emissions of all National Ambient Air Quality Standards (NAAQS) pollutants for calendar year 2014. This study will also calculate OCS non-platform emissions of all NAAQS pollutants for calendar year 2014 using Automatic Identification System (AIS) data and other sources. In addition to the emissions inventory development, the study will also obtain updated Air Quality spreadsheet templates used under 30 CFR 550 Subpart C in the post-lease assessment. Operators use these templates to estimate emissions and obtain post-lease plans approval. These updated spreadsheets must reflect the draft updated air quality regulations expected to be released in 2015. Additional tasks of this study include an emissions trends analysis and a hazardous air pollutants (HAPs) scoping study.

In 2015, the study entitled Fugitive Emissions Update – Component Count and Amounts will be contracted. This study will update the way fugitive emissions are calculated in the OCS

emissions inventories to assure GAO and BOEM have the best and most accurate emissions to use for economic and environmental analysis.

New information needs for FY 2016 consist of the Year 2017 Gulfwide Emissions Inventory Study. The 2017 inventory will assist states in conducting modeling for additional State Implementation Plan (SIP) demonstrations to meet changing air pollution requirements. The collection and compilation of an air emissions inventory is one of the tasks that BOEM conducts to assure coordination of air pollution control regulations between OCS offshore sources and State's sources onshore (as per Section 328(b) of the 1990 Clean Air Act Amendments (CAAA).

Fates and Effects

There are numerous examples of BOEM studies that have collected baseline information or examined the fates and effects of oil and gas activities in the OCS of the GOM. In the mid-1970's, the first major offshore environmental survey in the GOM was conducted in response to questions about the effects of oil and gas activities on the continental shelf. This study, Mississippi, Alabama, and Florida (MAFLA) examined physical, chemical, and biological parameters along the MAFLA shelf. Portions of the study area were revisited in the late 1980's for similar analyses as part of Mississippi-Alabama Marine Ecosystem (MAMES). Several other baseline studies informed the DWH Oil Spill Response and were summarized in the Operational Science Advisory Team's (OSAT-1) Report, comparing measured hydrocarbon concentrations against reference locations. BOEM's ESP has conducted numerous studies over the years and the sum of past, current, and future studies forms a strong environmental monitoring framework that guides BOEM's management decisions.

BOEM has also begun to focus on new issues that have arisen since past studies, such as ocean acidification, and considering new methodologies and techniques for characterization. As part of its Cumulative Impacts analysis for NEPA documents, BOEM must take into consideration the multiple stressors that could impact Gulf habitat in addition to oil and gas activities, including for example climate change. Ocean acidification is a major issue facing the world's oceans as atmospheric CO_2 concentrations rise, and it is expected to especially impact sensitive coral reef habitats. In response to this potential threat, BOEM initiated in FY2014 the following new study: *Coral Reef Ocean Acidification Sentinel Site in the Flower Garden Banks National Marine Sanctuary* (GM-14-05). As well, since the DWH spill, revising baseline conditions and answering fundamental (bio)geochemical questions is more important than ever. The region should be recharacterized to collect baseline data and to employ new technologies. Collecting baseline data for areas where future oil and gas activities may occur should also be considered. Furthermore, any studies as a result of the DHW oil spill should also be considered.

Several ongoing BOEM studies in the GOMR seek to better understand the fate and effects of oil spills, including the implications of various response activities. The DWH oil spill was the first of its kind in deepwater and the first time that dispersants have been injected near the seafloor for remediation purposes. Thus, more must be learned about the behavior of spilled oil, especially dispersed oil, under these specific conditions. Initiated in 2011, the *Simulation Modeling of Ocean Circulation and Oil Spills in the Gulf of Mexico* (GM-11-02) study will provide the agency with a next-generation, 3-D blowout model for the Gulf, including consideration of a variety of possible spill scenarios. In addition, the following ongoing study initiated in 2012 will

inform BOEM's OSRA modeling, especially related to surface transport of oil spills: *Remote Sensing Assessment of Surface Oil Transport and Fate during Spills in the Gulf of Mexico* (GM-12-02). Another topic of particular interest is how oil and dispersed oil might interact with sediment particles or undergo sedimentation in deepwater environments. An ongoing BOEM study procured in 2012, *Oil/Dispersed Oil-Sediment Interactions in Deepwater Environments and Impacts of Dispersants on the Environmental Fate of Persistent Oil Components* (GM-11-13), is investigating these topics.

New information needs for the GOMR in FY 2016 include an inventory to quantify hydrocarbon input from various natural and anthropogenic sources as well as their fates and effects. BOEM is required to evaluate the current state of GOM resources, including waters and sediments, as well as possible inputs from oil and gas activities that would result from BOEM's planned action or possible accidental events. One source of input to the GOM that must be considered is hydrocarbons (e.g., oil, gas, grease, and their components). An updated inventory of these sources, amounts, fates, and effects is needed to inform BOEM as to the contribution of each source to any potential impacts in the water and sediments.

Habitat and Ecology

A comprehensive understanding of Gulf ecology, as it relates to BOEM's mission, requires new information across a variety of habitat types, as well as updated information to document changing baselines. In some cases, information is also required on a Gulf-wide basis due to the connectivity of ecosystems across federal boundaries. New and ongoing energy activities touch upon every ocean province from our coastal marshes to the abyss. As oil and gas exploration has moved into deeper waters, BOEM has required new information on the potential impacts of activities down the continental slope and onto the abyssal plains. At the same time, new technology prompts renewed interest in hydrocarbon resources under the thick salt layers beneath the OCS, and there is considerable gas development activity in shallower shelf areas. Therefore, while BOEM needs to collect information in frontier areas where biological information is sparse, older data on shelf communities also needs to be updated.

A long-range systematic monitoring program is being developed by BOEM to adequately assess possible changes in environmental health due to energy activities, as required under OCSLA. Long-term monitoring at the Flower Garden Banks is an excellent example of such a systematic program and continues to be a centerpiece of BOEM's ESP. Better understanding of cumulative stressors at the Flower Garden Banks is required, such as the impacts of variable temperature and acidification, the latter also indicators of climate change. A study recently initiated in FY2014 will establish the banks as a sentinel site for ocean acidification monitoring to better understand possible impacts of this particular stressor. New studies currently proposed for FY 2016 will extend the *Flower Garden Banks Long-Term Monitoring Program* for several more years, in partnership with the Sanctuary. Sampling under this new study will be informed by a current study assessing the most appropriate timescale of sampling at FGB, in order to optimize effort at the banks. Partnerships with other agencies continue to play an important role in establishing long-term environmental monitoring programs, and BOEM is actively involved in establishing such partnerships and leveraging opportunities through RESTORE Act programming.

Adaptive management is an important aspect of the regulatory process and is a necessary aspect of BOEM ensuring minimal impacts of energy activities on the environment. Periodic review and updates of information on GOM habitats ensures that protective measures are adequate and that adaptive management practices are implemented. It is especially important that BOEM continues to assess impacts on deep water environments, with the increased activity of oil and gas development in those waters. Two new studies proposed for FY2016 are designed to specifically assess potential impacts on habitat in the deep water environment. The first study, *Gulf Oxygen Deepwater Experiment (GODEX)*, would follow-up on the recommendations of the previous MMS 2005 oxygen study, collecting field and experimental data required to assess deep water oxygen dynamics and possible impacts of oil and gas development, such as from spills. This study would also take a Large Marine Ecosystem (LME; gulf-wide) approach, given the movement of water masses across international boundaries, involving both U.S. and Mexican scientists and facilitating international coordination. The second deep water study proposed for FY2016 is the profile: *Potential Effects of Oil and Gas Exploration and Development on Benthic Communities at Selected Deepwater Sites (>2,000m) in the Gulf of Mexico*. The main objective of this study is to assess the potential effects of drilling in deep waters by documenting drilling mud and cuttings accumulations, physical modification/disturbance of the seabed, debris accumulations, and effects on benthic organisms.

In addition to field research, BOEM also has an increasing need for ecosystem models which can both simulate the present state of habitat and populations, as well as predicting future change under different perturbation scenarios. This predictive need for assessing the potential impacts to marine biota from oil and gas activities is identified in OCSLA. For example, BOEM needs information on the spatio-temporal variability of planktonic distributions and related higher-trophic habitat to address the potential gulf-wide impacts of industry on these communities in the GOM. Modeling tools can be used to provide simulations of longer time spans and at higher spatial resolution than can be achieved with ship-based sampling alone. A new study for FY 2016 proposes to use a gulf-wide ecosystem model and International Panel on Climate Change (IPCC) scenarios to provide projected habitat conditions in Gulf OCS habitats, with focus on habitats of special interest to BOEM.

Marine Mammals & Protected Species

A high priority right now in the GOM is measurement of the ambient noise environment to understand potential impacts of noise-producing oil and gas activities on protected species. Thus, the following study is proposed for FY2016: *Passive Acoustic Monitoring (PAM) Program for the northern Gulf of Mexico*. This project will establish a long-term passive acoustic monitoring program using moored acoustic recorders at permanent stations throughout the GOM.   The program will establish a "baseline" for ambient noise in the GOM against which to judge potential future noise impacts from BOEM/BSEE activities as well as characterize the sound budget from other kinds of noise already occurring in the GOM (e.g. shipping). In addition, acoustic recorders will be able to detect vocalizing marine mammals, providing both spatial and temporal information about cetacean species in the GOM. A new study also proposed for FY2016 will continue to test the effectiveness of BOEM mitigations: *Seismic Survey Mitigation Measures and Marine Mammal Observer Reports*. This study will provide an update to a previous study which analyzed seismic survey observer reports from 2002 to 2008 and, based on

the results of the analysis, will make recommendations as to the effectiveness of specific mitigation measures.

Social & Economic Sciences

Socio-Economics

The GOMR approaches social and economic impacts from OCS activity from three basic directions and with multiple methodologies. First, the ESP emphasizes the industry itself. The industry's size, variability, and longevity mean that characteristics and distributions of its various sectors shape the socioeconomic baseline, and that data on these sectors is needed to calibrate the models used to estimate its consequences and future effects. Much ESP effort describes and measures key industry sectors (e.g., drilling, production, fabrication, transportation) and uses this information to assess local and regional impacts. The move into deepwater, growing interest in alternative energy and renewed interest in the Atlantic, and the push to address local-level effects are significant concerns in the Gulf. The second strategy focuses on developing a "dynamic baseline." All SIA begins with the baseline but, in the Gulf, the need to disentangle industry effects from other trends and events turns this into a substantial and iterative task. Much past ESP research aimed at developing this baseline and the growing State and stakeholder emphasis on local-level impacts has sharpened this focus. A third strategy focuses on standard SIA social and cultural issues. Many of the current issues relate to the DWH spill.

In terms of number, if not budget, the majority of ongoing Gulf socioeconomic studies are cooperative agreements conducted under the LSU CMI (see the GOMR studies webpage for more information). New information needs for FY 2016 include a study that proposes to describe and quantify the socioeconomic impacts and recreational uses of OCS infrastructure. Offshore recreational activities, such as fishing and diving, contribute significantly to the social and economic frameworks of many communities along the Gulf Coast. However, the currently available data does not describe how much of this economic activity is dependent on OCS infrastructure.

The GOMR has been reexamining questions of geographic focus. The current onshore analysis area consists of the 132 counties/parishes from Texas to the Florida Panhandle, and these are aggregated into 13 Economic Impact Areas. The GOMR is preparing a revised version which will include 23 Economic Impact Areas built largely on the distribution and activities of oil-related industries. As part of this preparation, BOEM is conducting a study that is analyzing the regional economies of the newly proposed impact areas and their relationships to the OCS industry. One objective is to improve our understanding of the linkages between offshore activities on the OCS and onshore activities in support of the OCS. A related objective is to support BOEM economic modeling. This study will also help define longer-term information needs regarding baseline description. For example, past research will need to be updated and synthesized to reflect the modified focal areas.

Submerged Cultural Resources

Submerged cultural resources are both non-adaptive and non-renewable and are protected by a well-established body of laws and regulations at both the Federal and State level. An ongoing

information need for the GOMR is to understand the impacts of the 2010 DWH oil spill on archaeological resources within the coastal and marine environments. Impacts to submerged archaeological resources are not addressed as part of the NRDA process for the DWH spill. In addition, no studies of impacts to archaeological resources from the spill are being funded through other sources such as the Gulf of Mexico Research Initiative, National Academy of Sciences, and RESTORE Act Science Program therefore a significant information gap exists. In order to fill this information gap, BOEM is currently funding two studies that are examining potential impacts from the 2010 spill on archaeological resources. A new study procured in FY 2014, *Testing and Assessment of the Effects of an Oil Spill on Coastal Archaeological Sites* (GM-14-04), is examining the impacts of the oil spill and associated clean-up activities on coastal prehistoric sites in Louisiana. Information gathered during this study will also benefit the State of Louisiana.

A study procured in FY 2013, *A Comparative Analysis of an Oil Spill on the Biota Inhabiting Several Gulf of Mexico Shipwrecks* (GM-13-03a, b, and c), is analyzing and comparing the effects of oil and dispersant exposure from the 2010 DWH oil spill on wooden and metal-hulled shipwrecks. This project, renamed *Gulf of Mexico Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology, and Archaeology (GOM-SCHEMA)*, is examining shipwreck microbiomes and resident microbial communities at sites within and outside of the spill area to inform about their current state of preservation as well as assess ecosystem recovery after a major environmental disaster through microbial ecological analyses.

Other studies continue to inform BOEM about impacts to submerged cultural resources from various offshore activities. One ongoing study procured in FY 2012, *Analyzing the Potential Impacts to Cultural Resources at Significant Sand Extraction Areas* (GM-12-04), is investigating potential impacts to offshore sand resources and shipwrecks associated with dredging activities to support coastal restoration and protection projects in Louisiana. BOEM continues to seek to understand the nature of submerged cultural resources to ensure they are not harmed as a result of the bureau's permitted actions.

New studies proposed for FY 2016 include continuation of the archaeological investigations at the Monterrey shipwrecks in Keathley Canyon. The three Monterrey shipwrecks represent one of the most significant archaeological discoveries in the deepwater GOM and additional information gleaned from these sites will inform BOEM as to their current state of preservation and effect on marine biodiversity in an area not yet developed for oil and gas extraction. Another study for FY 2016 proposes geophysical data collection and testing of potential preserved paleolandforms associated with the McFaddin Beach, Texas prehistoric site, an area that has yielded a substantial number of Late Paleoindian- and Early Archaic-era artifacts and faunal remains. Identifying and testing the geophysical indicators of preserved paleolandforms in the northwestern GOM and their potential for containing cultural materials will allow BOEM to more adequately identify, protect, and manage these submerged cultural resources while ensuring BOEM-permitted oil and gas and marine minerals activities do not impact them. A third study proposed for FY 2016 is to examine the use of 3-D seismic data as a tool for mapping submerged paleolandforms that might contain preserved evidence of prehistoric human occupation of the OCS.

4.3 MARINE MINERALS SCIENCE STRATEGY

Marine Mammals and Protected Species

In accordance with Section 7 of the Endangered Species Act (ESA), BOEM is required to consult with the NMFS for potential dredging effects on protected species and their associated critical habitats. Based on the history of dredging activities in the Atlantic and Gulf of Mexico OCS, federally protected sea turtles are documented to be the most vulnerable to direct entrainment by dredging operations. USACE and other federal partners have made a significant investment in improving protective measures and best management practices, principally focusing on dredging windows, the use of sea turtle deflecting dragheads, and relocation trawling in advance of dredging operations. However, there has been little effort to analyze and subsequently tailor these mitigation strategies to project specific scenarios. The MMP is currently pursuing a new FY 2015 study titled "Development of a Decision Support Tool to Reduce Sea Turtle Dredging Entrainment Risk." This study will evaluate and document entrainment risk parameters for dredging activities in the OCS and develop a geographically and temporally based decision support tool to assess project specific dredging entrainment risk and guide mitigation planning decisions within state and federal marine mineral resource areas. One of the data parameters identified to be integrated into the tool is the temporal and spatial relationship of sea turtle behavior (i.e. foraging, migrating, etc.) within the water column relative to draghead operating parameters. These site specific behavioral data are limited throughout the range of existing and future lease areas for sediment resources. The decision support tool will serve as the "umbrella" framework to integrate project centric data for risk based planning and analyses.

To continue to build upon limited behavioral and habitat data, MMP is pursuing studies on sea turtle behavior relative to sediment resource areas and associated dredging activities. The MMP is proposing to leverage opportunities associated with existing BOEM relocation trawling activities to tag, sample, track, and analyze the behavior of captured sea turtles. Fine-scale information on dive profiles, life history characteristics, and foraging activity is lacking for sea turtles in the GOM. Combining this fine scale movement information with genetic stock analyses, population demographics, health and foraging studies will allow us to address information gaps as identified through the NEPA process and through ESA Section 7 consultations as required in BOEM's current authorizations. These authorizations require gathering of missing or incomplete data on species to make informed management decisions within BOEM. Results would support data needs related to hazardous spills and decommissioning activities, dredging and trawling associated with coastal restoration programs, and provide knowledge of sea turtle movements and dive behaviors along with their relationships to critical habitats within BOEM Planning Areas. This study would be conducted in collaboration with USGS to fulfill expertise and permitting needs as they possess the expertise and permits required from NMFS to collect biological samples and tag specimens.

Information Management and Data Sharing

Focused mapping efforts are being pursued for the GOM. Much of the GOM OCS west of Mobile Bay is characterized by a dominantly muddy seafloor separated by discrete, large sand bodies; as such, there has been a focused effort over the past two decades by BOEM, USGS, and

Gulf states to inventory these sand resources. BOEM anticipates that by FY 2017 these data will be assembled into a geodatabase that will provide a regionally consistent dataset. MMP will expand this database in the future in the Gulf to incorporate other considerations such as EFH, hard-bottom areas, oil and gas pipelines, and sensitive cultural resources to help identify conflicts and contemplate impact trade-offs.

The MMP also hosts a regional SMWG in the Gulf to encourage discussion about past, ongoing, and future projects, potential environmental concerns, study needs, and lessons learned. Active stakeholder engagement through the SMWG and participation in regional planning groups (e.g. GOMA, etc.) ensures that the MMP maintains connectivity with decision makers throughout the Gulf regions and aligns study investments with priority needs

Tables of proposed studies for the GOMR are included in Appendix I. Profiles for these proposed studies are provided in Appendix II.

4.4. FUTURE PLANS

4.4.1 Conventional Energy Future Plans

Decommissioning

There are now under 2,000 oil and gas platforms remaining on the U.S. OCS. In recent years the number of removals has increased and this activity will likely remain elevated; over the last decade, platform removals have begun to outpace emplacements. Bottom-founded platforms supply an artificial hard substrate that spans the water column, potentially changing diversity and altering the distribution of species where they are located. Since the 1980s, Gulf States have been granted permits to reef decommissioned oil and gas platforms through the Rigs-to-Reefs Program. The practice of reefing platforms has gained acceptance and use over time as more than 400 platforms have now been reefed. Over 500 reefing locations and multiple reef planning areas and zones have been approved on the Gulf OCS where public and private artificial reefs have been deployed with the objective of enhancing recreational activities, increasing fish production and/or furthering research.

As decommissioning continues, there remain gaps in understanding how the OCS will be influenced. Will the Gulf States continue to request the decommissioned oil and gas platforms for artificial reef material? Will the percent of decommissioned platforms used increase? How will the removal of large numbers of oil and gas structures affect the ecosystem of the GOM? Planned and ongoing studies will address these and additional research gaps. For example, the *Explosive Severance of OCS Structures* study is now being procured and will quantify the impact to fishes and fisheries resulting from explosive severance methods as employed in the current and anticipated OCS environment.

Deepwater

BOEM will continue to design and perform studies to understand potentially changing baselines in deep water habitats and how best to protection these regions. The stakeholder community recognizes the especial importance of these studies as the number of direct and indirect stressors

to these habitats grows, including from oil and gas activities, deep-water fishing, marine pollution, and climate change. Deepwater habitats, including the mid-water pelagic realm, represent an important economic and scientific frontier, but are the least understood marine environments of the GOM. Several major deepwater studies are ongoing to broaden our limited knowledge base of deepwater benthic ecology, including studies of plankton, coral distributions, and Potentially Sensitive Biological Features (PSBF's). For example, the final report was just published for the study *Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico*. The results from these studies will lead to new areas for further investigation.

Several major studies have recently completed measurements of currents in deepwater. This dataset spans the GOM from 87°W to 97°W and down to 24°N in Mexican waters. Ongoing studies are examining the Loop Current and making Lagrangian observations of deep currents over the entire Gulf basin. The next step will include modeling of the data and incorporation of the information into oil spill assessments and cross referencing with pelagic biology studies.

Cumulative impact analyses are an area of interest that the agency seeks to continue improving. As part of its NEPA obligations, BOEM subject-matter-experts are required to perform an assessment of the multiple stressors that can impact environmental resources, in order to determine potential contributions of oil and gas activities in addition to other impacting factors. New and improved methodologies for performing these analyses are currently being explored and have been implemented in other regions, such as the Mediterranean. The following study is proposed for FY 2017 to develop potential new approaches: *Cumulative Impacts of Human Activity on Coastal and Marine Ecosystems of the Gulf of Mexico*. The objective of this particular study will be to complete an analysis of the cumulative impacts to selected biological, physical, and cultural resources resulting from oil and gas development and other human activities in the GOM, including from coastal to deepwater communities.

Recent archaeological discoveries made in deep and ultra-deep water suggest a greater number of historic shipwrecks far from land off the continental slope than was previously expected from prior BOEM studies. One study completed in 2011 investigated the potential for vessel losses along the Vera Cruz-to-Havana route routinely followed by Spanish sailing fleets, which would have taken them through the southern boundary of the EEZ. Another study in the Gulf and one study in deep water off Virginia combine archaeological investigation of deepwater shipwrecks with biological characterization of the organisms that have colonized them. A study initiated in FY 2013 is examining microbial community structure and function on deepwater shipwrecks as a result of exposure to oil and dispersant. Microbial response to environmental perturbations could affect the natural processes of wood degradation and metal corrosion which, in turn, could have implications for site preservation as well as continued availability of hard structure for recruitment of motile fauna, corals, and other deepwater biological communities. Long-term monitoring of shipwrecks and their resident biota can inform BOEM, not only of impacts to cultural resources from BOEM-permitted activities, but also of ecosystem recovery from events such as the DWH spill. As such, understanding the diversity of resources, site formation processes, and their potential eligibility to the National Register of Historic Places is a concern for designing appropriate mitigation strategies to fulfill agency obligations under Section 106 of the NHPA.

Fates and Effects

Fates and effects studies are performed in the GOM to evaluate the physical-chemical and biological processes that affect the impacts of oil and gas drilling and production discharges, spilled oil, and chemical dispersants on biological communities. The OCS supports large and valuable commercial and recreational fisheries, various threatened or endangered species including sea turtles and marine mammals, and unique benthic communities. Concern has been expressed that the oil and gas industry may contaminate these resources or alter the supporting ecosystem. Understanding the chronic, sublethal impacts that may be associated with offshore oil and gas activities is a concern to many. Questions continually arise as industry moves into deeper water and new technology is applied; the DWH oil spill further served as a reminder of this. Several ongoing and recently initiated studies are addressing fates-and-effects issues in the GOM, including development of a new 3D blowout model (GM-11-02), applications of remote sensing to understanding spill movement (GM-12-02), and the impacts of anthropogenic noise on marine mammals and sea turtles (GM-13-05). The ongoing Gulf SERPENT project is collecting measurements of deep sea pelagic and benthic communities, which over the long-term have proven useful in identifying pre- and post-spill impacts. Additionally, improved understanding is required of explosive removals on Gulf fish populations and of the ambient noise environment in the Gulf. The studies program is continuously addressing the information needs in this constantly evolving area and will develop new studies as the need arises.

Monitoring

The development of long-term monitoring programs is of international interest for measuring trends in ecosystem indicators and assessing the vulnerability and resiliency of human and natural systems. Given its broad scope, the design and implementation of monitoring efforts are currently engaging multiple interested partners, including Federal and State agencies, academia, and industry, drawing from expertise in both the U.S. and Mexico. Monitoring programs would provide BOEM the long-term data sets necessary to evaluate the effectiveness of mitigations and stipulations placed on developers to ensure the protection of natural and cultural resources. The analysis of long-term data collected from monitoring programs also reveals trends as biological populations and oceanographic conditions shift in response to perturbations, such as hurricanes, oil spills, periodic climate events, ocean acidification, and/or climate change. With these data available, mitigation requirements can be adjusted to be more effective, analysis of cumulative effects in NEPA documents will be more robust, and approaches to addressing climate change may be uncovered.

The agency is working closely with the stakeholder community to implement new programs for studying and monitoring the Gulf environment. In particular, BOEM is partnering with and leveraging research to be performed under RESTORE Act programs. Thus far, we are working with partners through RESTORE on proposals for monitoring of deepwater coral communities in the Gulf and expansion of other long-term monitoring and ocean observing programs. Current monitoring-related activities performed by BOEM and/or BSEE include pre- and post-activity surveys, Flower Garden Banks Long Term Monitoring, the Gulf SERPENT program, NTL ocean current monitoring, and the Protected Species Observer (PSO) program during seismic surveys. Given marine sound as an important topic, the agency is currently looking towards implementation of a Passive Acoustic Monitoring (PAM) network in the Gulf and other

measures determined by BOEM's current development of a Long-Term Monitoring Program (LTMP). The goal of this program would be to help protect marine mammals from potential impacts during G&G activities by monitoring for any long-term impacts in this regard.

Social Sciences and Economics

A previous section described the challenges facing Gulf Region social impact assessment (SIA) and the three basic approaches taken to address them. This section discusses Gulf social and economic information needs in the long-term.

Industry focus: As the world's most developed offshore oil province, the intensity and variability of OCS activities respond to worldwide trends in the petroleum industry, energy markets, and business practices.

The GOMR will continue efforts to define, describe, and measure OCS industry sectors that drive its onshore impacts. Service ports are vectors for many industry impacts but have proven particularly difficult to address and, currently, BOEM is engaged in limited efforts to address this issue through an annual purchase and analysis of GOM vessel movement data. Ports function as hubs of an intermodal transportation system where material destined for the OCS is transferred from inshore modes of transportation to offshore ones. Past BOEM research addressed the offshore leg of this system; planned research will address the onshore leg, with a particular emphasis on the trucking industry.

BOEM estimates of future OCS-related economic activity are based on past industry behavior. Developing and updating these data is an ongoing need. Past experience has led BOEM to a strategy that emphasizes public, commercial, and expert information sources. The approach is iterative, progressive, and assumes that most data will be pieced together or extrapolated and that each study will build on the last. The GOMR expects that it will eventually include a limited use of more burdensome collection methods (e.g., workshops, industry surveys) for data deemed critical and "good enough" estimates are unavailable.

Baseline focus: The GOMR has been reexamining questions of geographic focus. The current onshore analysis area consists of the 132 counties/parishes from Texas to the Florida Panhandle, and these are aggregated into 13 Economic Impact Areas. The GOMR is preparing a revised version which will include 23 Economic Impact Areas built largely on the distribution and activities of oil-related industries. As part of this preparation, BOEM is conducting a study that is analyzing the regional economies of the newly proposed impact areas and their relationships to the OCS industry. One objective is to improve our understanding of the linkages between offshore activities on the OCS and onshore activities in support of the OCS. A related objective is to support BOEM economic modeling. This study will also help define longer-term information needs regarding baseline description. For example, past research will need to be updated and synthesized to reflect the modified focal areas.

Topical Focus: The DWH oil spill and its aftermath define much of the current topical focus. BOEM completed a study that began within days of the event and has documented socioeconomic consequences as they occurred and changed. The oil spill has raised the profile of questions related to multiple uses of the coastal environment. Along with updating baseline

information, ongoing and planned research on subsistence, commercial fisheries, recreation and tourism, and environmental justice will all assess the oil spill's long-term consequences. The GOMR will also continue to pursue its systematic reexamination of standard and OCS-specific SIA topics (see NRC, 1992). Field-based research in the 1990s proved to be a powerful tool for understanding the relationships of Gulf Coast communities and families to the oil industry. Similar research is being considered that would reassess earlier findings in the light of changes to the industry that have occurred. These broader studies may identify more focused needs, such as the assessment of local-level fiscal impacts on education or health systems. The DWH oil spill is a watershed, baseline-changing event. Future study efforts must address it. Still, over decades of OCS operations, the Gulf Region's economy and society have largely adjusted to its demands and opportunities, and many typical SIA effects occur only under unusual circumstances, or not at all, or are difficult to separate from the "background noise."

Submerged Cultural Resources

For FY 2017 and beyond, BOEM envisions continuing the GOM-SCHEMA study to obtain a better understanding of the impacts of the 2010 DWH oil spill on shipwrecks and their microbial communities as well as conduct long-term monitoring and measure ecosystem recovery at these important archaeological sites. Another study proposes to conduct a NRHP-eligibility and historical significance determination for the sunken drilling rig, *C.P. Baker*, the first drilling rig of its kind. This vessel is unique due to its architectural design and is also associated with the first rig blowout in U.S. history, which resulted in substantial changes to the offshore oil and gas industry.

4.4.2 Marine Minerals Future Plans

As a result of the recent Deepwater Horizon oil spill event in the GOM, an increase in the demand for Gulf OCS sand resources to support restoration projects over the next five years is anticipated. RESTORE act and NRDA funding along with BP fines will support a wide variety of coastal restoration projects across the Gulf coast. Each of the five Gulf States has and will receive substantial funding and as such, each state has established working groups to develop strategies and establish restoration proprieties. Through various venues such as the Gulf of Mexico Alliance (GOMA), the MMP is working with the five Gulf States, Federal agencies, academic organizations, businesses, and other non-profits in the region to develop a Regional Sediment Management (RSM) plan to support these long term restoration efforts along the Gulf coast.

The following studies represent ongoing MMP investments in the Gulf of Mexico which will support RESTORE Act and NRDA efforts:

- Environmental Investigation of the Long-term use of Trinity and Tiger Shoals for Large-scale Beach and Coastal Restoration in Louisiana (partnership with State of Louisiana)
- Wave-Bottom Interaction and Bottom Boundary Layer Dynamics in Evaluating Sand Mining at Sabine Bank for Coastal Restoration, Southwest Louisiana (partnership with State of Louisiana)
- The Development of an Offshore Alabama Sand Information System (partnership with State of Alabama)

- Sand Resources of the Southeast Texas Continental Shelf (partnership with State of Texas)
- Sand Resource Evaluation on the Outer Continental Shelf by the Florida Geological Survey, Louisiana Office of Coastal Protection and Restoration, and Virginia Division of Geology and Mineral Resources

While the scope of RSM and borrow area monitoring extends beyond environmental impacts concerns, it is important that BOEM manage borrow areas on a regional scale in order to minimize potential impacts, cascading and cumulative. Moreover, monitoring of existing borrow areas subsequent to dredging activity is important to document and understand the physical evolution of the borrow area and track the timing and nature of habitat recovery. Physical evolution of dredged borrow areas on the OCS is poorly understood, and could vary greatly in different locations due to physical oceanographic parameters, sediment supply, storminess, and borrow area design. While borrow area evolution is expected (e.g. expansion of sea floor depression beyond extent of dredging activity) and mitigation measures are currently being applied to protect adjacent areas, the basis for assigning setbacks does not consider these localized impacting factors and the efficacy of existing mitigations have not been monitored or adaptively managed.

BOEM continues to study how dredge areas evolve and potentially impact infrastructure and/or resources of concern located adjacent to the pit. However, site-specific data required to make accurate predictions and empirical measurements to test and validate predictive models are only available for a few of the OCS borrow sites because of a lack of a comprehensive borrow area monitoring program. This initiative would involve development of a comprehensive, systematic and repeatable framework for acquiring data (time series seafloor surveys, instrument deployment, etc.) at representative borrow areas on the OCS. This effort will build on BOEM's investment toward better understanding this problem by filling data gaps and refining predictive models developed during previous studies. It will also evaluate the effectiveness of mitigation measures applied to existing borrow areas (e.g. setback distances from pipelines or hard bottom benthic habitats) to determine if resources and infrastructure are being protected. Results will increase BOEM's decision making ability regarding safety and protecting environmental and cultural resources and provide for better management of valuable OCS sand resources. The influx of projects that MMP is presently experiencing on both the Gulf and Atlantic OCS will provide a unique opportunity to document baseline conditions and implement a monitoring program immediately after dredging has been completed.

CHAPTER 5   PACIFIC STUDIES

5.1 Introduction

The ESP in the Pacific OCS Region (Pacific Region) started in 1973. Over its forty-year history, the Program has evolved in response to (1) change in the geographic areas of concern and study, (2) change in the emphasis of disciplines highlighted for research, (3) change in the status of the Region from a frontier to a mature oil and gas producing area (shifting the emphasis from prelease to postlease), and (4) change to a frontier area for renewable energy production. The BOEM Pacific Region's responsibility now encompasses ongoing oil and gas operations and potential renewable energy development from both wave and wind energy. The area of importance for the Pacific Region stretches from the U.S.-Mexico border to the U.S. border with Canada, as well as the area around the State of Hawaii. The Pacific ESP is evolving and expanding our area of study commensurate with the emerging Pacific OCS renewable energy program, and with formation of OCS Renewable Energy Task Forces with the States of Oregon and Hawaii.

For the FY 2016-2017 SDP, BOEM Pacific Region participated in outreach to many thousand stakeholders for input. They included both public and private academic institutions, federal and state agencies, Tribal governments, private consultants, and representatives of Native Hawaiian interests. The Pacific Region received 39 study ideas from stakeholders, including several universities, consultants, NOAA, NPS, USFWS, and the USGS.

This SDP reflects BOEM Pacific Region's need to continue to monitor, through research, the environmental effects from ongoing oil and gas production operations and near-term decommissioning. It also explains the need for information to regulate future renewable energy projects that may be proposed and implemented in the Pacific Region. These energy projects require studying areas well outside the oil and gas production area of southern California, as interest and resource potential for deepwater wind and wave energy facilities exist along the entire U.S. West Coast and offshore Hawaii (Figures 5.2 and 5.3). BOEM has asked the Department of Defense (DOD) to review their use of the OCS and provide the bureau with potential zones that, due to military needs, would be excluded from renewable energy leasing off Hawaii and Oregon. DOD responded in 2013 that there are no off-limit areas on the Oregon OCS. DOD indicated in 2014 that there could be available areas that will not interfere with national security; however OCS areas that are very close to major naval operating centers will likely be off limits.
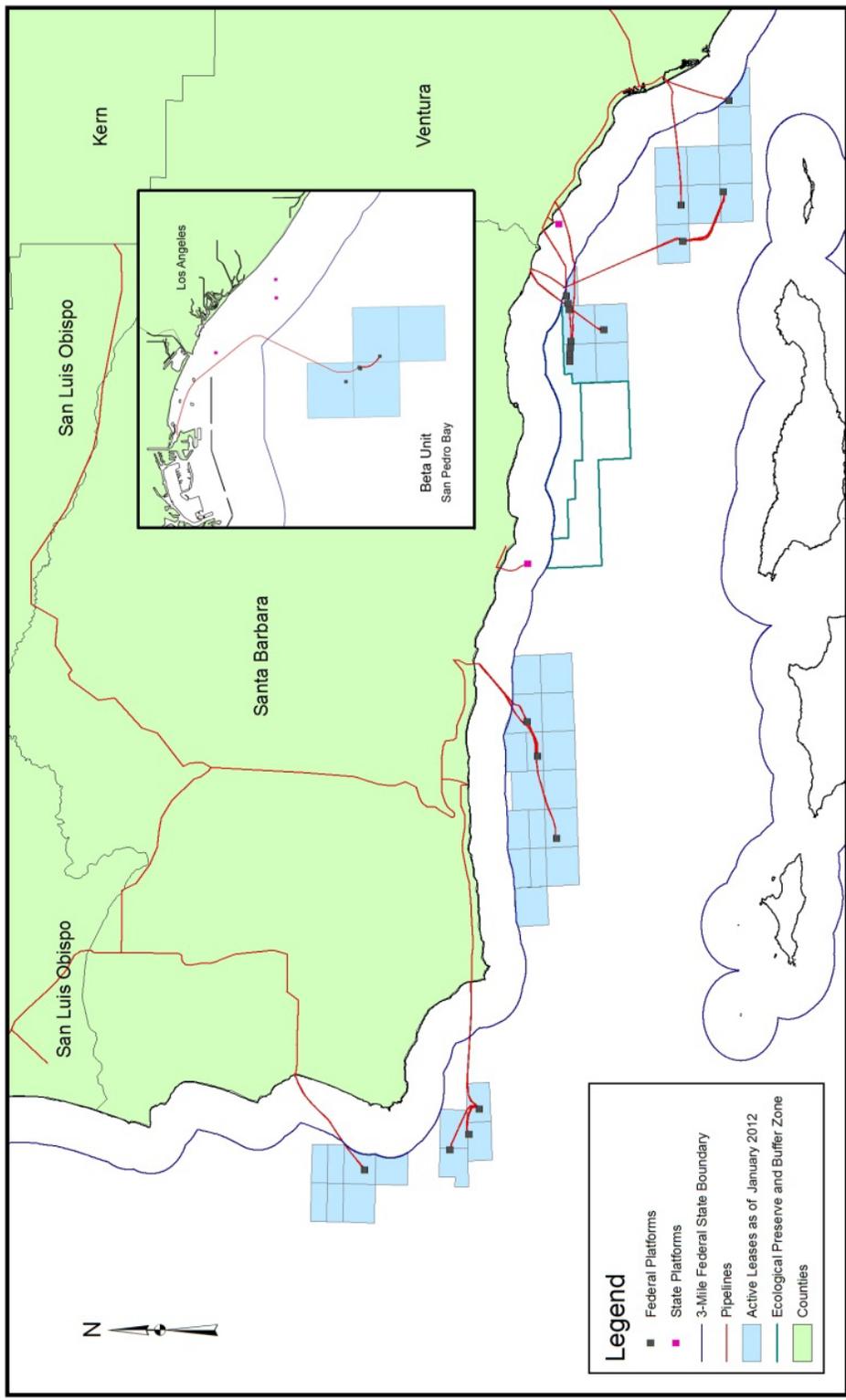
Figure 5.1. Oil and Gas Leases and Facilities in the Pacific Region

Figure 5.2. Wave Resource Potential for the U.S. West Coast and Hawaii (NREL n.d.)
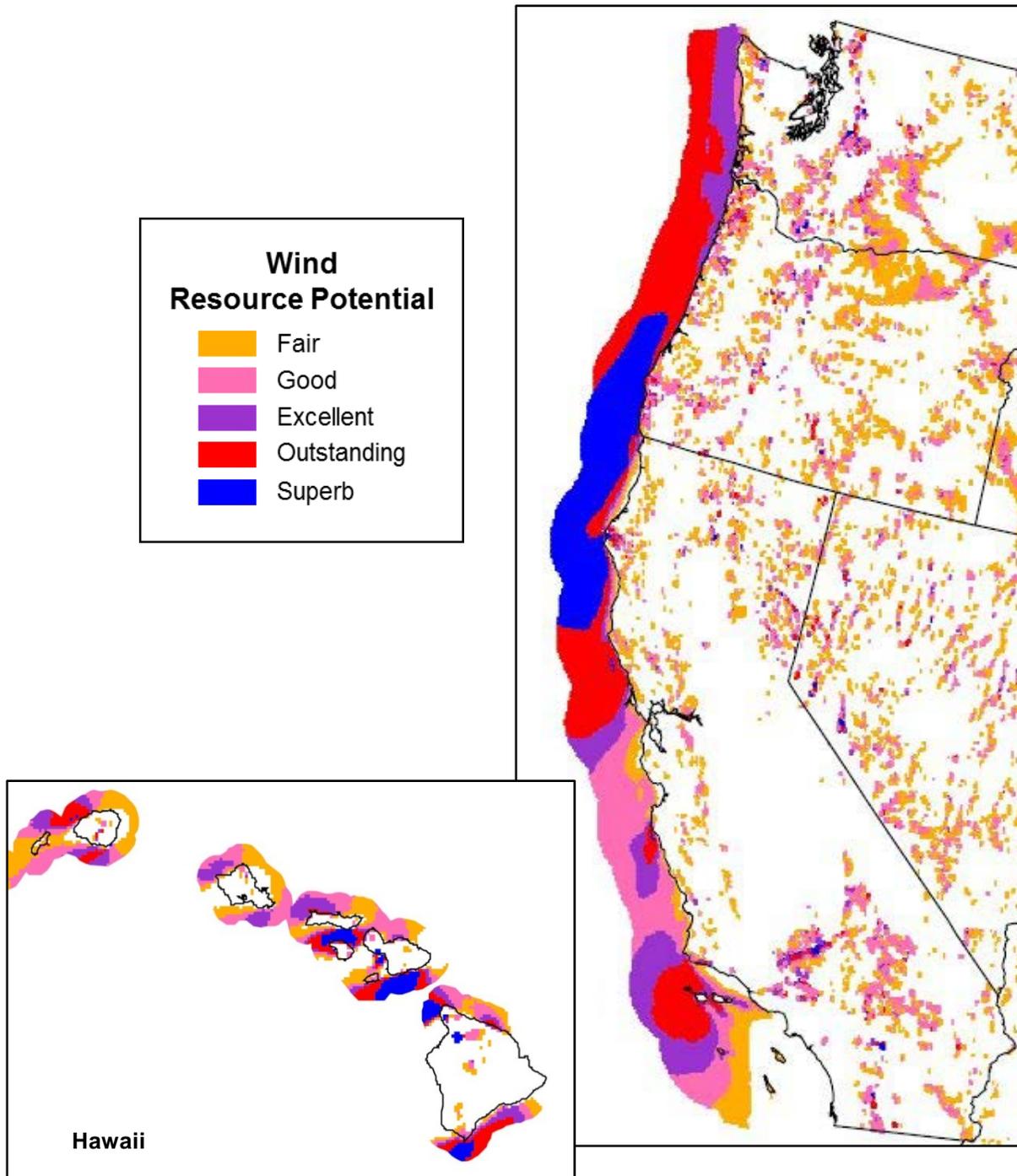
Figure 5.3. Wind Resource Potential for the U.S. West Coast and Hawaii (NREL 2009).
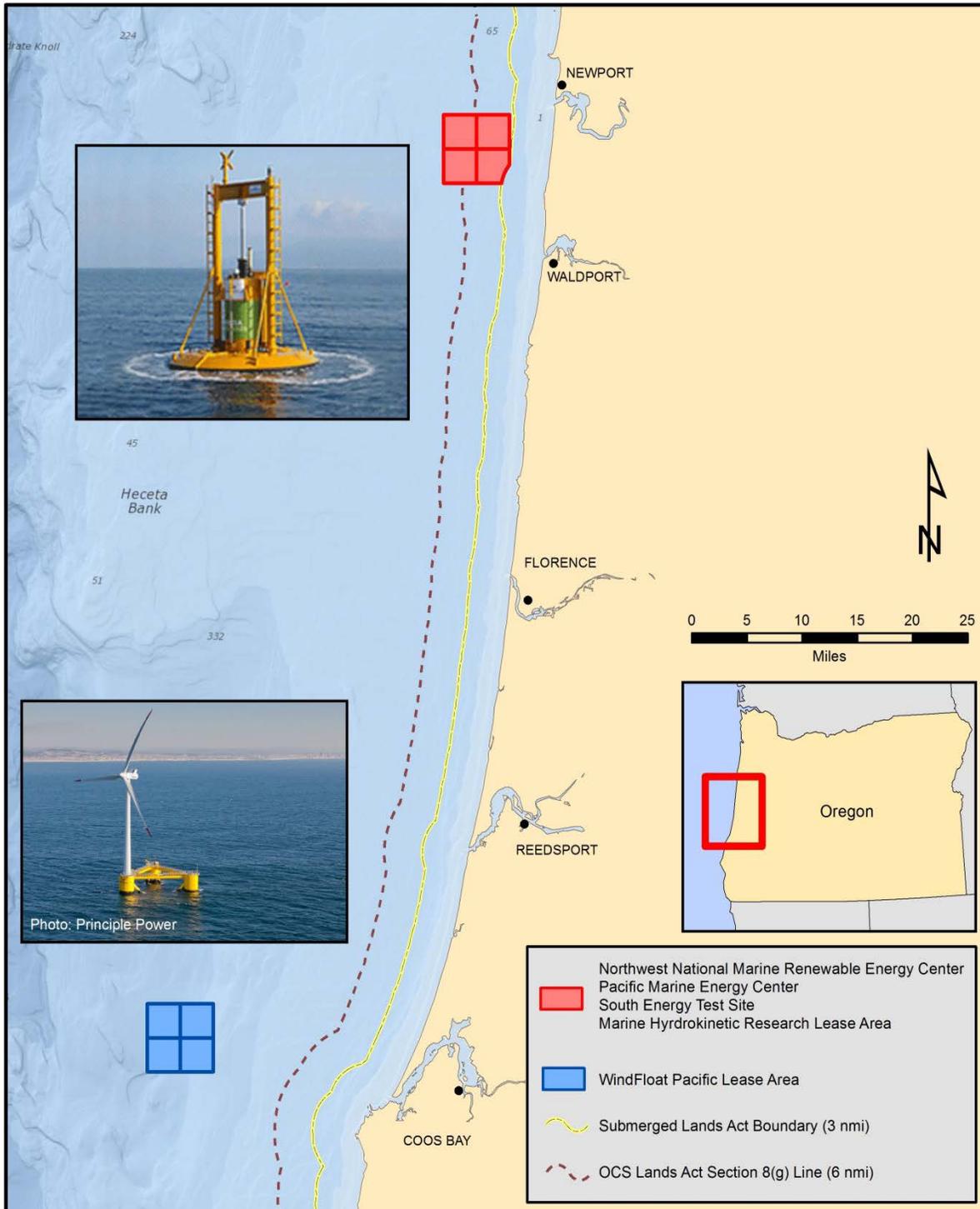
Figure 5.4. OCS Renewable Energy Projects in the Pacific Region

5.2 Conventional Energy Science Strategy

Typically, the OCS oil and gas management program is addressed as prelease and postlease. Prelease activities include those leading to the development of a 5-year program in which oil and gas lease sales are scheduled. Due to repeated moratoria, the Pacific Region has not been included in a 5-Year Oil and Natural Gas Leasing Program since 1987. However, Existing production and development activities on 43 producing oil and gas leases offshore southern California will continue (Figure 5.1). Annual production from these leases is currently 18.6 million bbls of oil and 27.6 billion cf of natural gas. Continued production at these facilities may present new information needs during the coming years in order to maintain environmentally safe operations with the existing infrastructure.

Decommissioning was a major topic for study in FY 2004, with the formation of a Pacific Region ESP Decommissioning Initiative. Despite a substantial decrease in oil and gas prices, aging infrastructure, and regular communication with industry, it continues to be difficult to predict when decommissioning will actually occur. Federal regulations (30 CFR Subpart Q, 250.1700-1730) require a two-year notice and planning period for decommissioning OCS facilities in the Pacific Region. To date, no company has officially initiated the two-year process. However, the Pacific Region must plan well in advance. The ESP study funding cycle includes a two-year lead-time from the initial idea to potential funding. Several more years are required to complete research and acquire the needed information. Most research ideas are not funded, which is a reflection of the vastness of the OCS, the monetary value of the produced energy (conventional or renewable), and limited budget allotted to the entirety of BOEM regions.

Studies proposed in this SDP address information gaps, inform environmental reviews of new and revised oil and gas development plans, support the Bureau of Safety and Environmental Enforcement's permitting and regulation of the oil and gas industry's ongoing production projects. Studies are needed to address and monitor the environment associated with offshore activities, especially those adjacent to the existing facilities. There is limited time to answer immediate questions regarding decommissioning, and studies must be planned well in advance, for major activities that have never occurred in the Pacific Region and will actually be the first for BOEM when industry removes ultra-deepwater complex platforms.

BOEM Pacific Region must acquire information from studies to inform decisions on existing and new production activities, potential decommissioning, and on the risks inherent to those activities (e.g., oil spills). Near-term decisions include those associated with pile driving of conductors, new and/or continued drilling, construction near and on platforms, repair and installation of power cables, pipeline maintenance and replacement, and potential decommissioning.

The goals and objectives of BOEM's Pacific Region science strategy for conventional energy are:

> ➢ Goal 1: Continue to monitor the environment during oil and gas operations
> > Objectives:
> > > ▪ Improve and expand oil spill modeling
> > > ▪ Characterize unsurveyed shoreline communities near platforms
> > > ▪ Revisit species and habitats in a changing environment of sea level rise

> ➢ Goal 2: Continue to prepare for decommissioning
>> Objective:
>>> ▪ Evaluate the condition of benthic environments near platforms

Proposed studies in support of these objectives are described below by discipline.

Fates and Effects

BOEM Pacific region currently uses the General NOAA Oil Modeling Environment (GNOME), which is a two-dimensional oil spill model, for oil and gas risk analysis. This model can only predict oil spill risk to surface biota and to habitats located on the beach and the intertidal zone. However, it is widely known that oil spills also can transport oil and its by-products into the subsurface, both the water column and the sediments, posing a risk to pelagic and benthic biota. The fate and transport of oil spills in southern California could be predicted using a high-resolution three-dimensional oil spill model. Predicting the three-dimensional fate and transport of oil spills will allow BOEM to assess the risk to subsurface biota and meet the needs of the BOEM Pacific Region's offshore oil and gas program. The proposed study *Assessing the Impact of Oil Spills to Subsurface Biota using Three-Dimensional Oil Spill Modeling* will allow BOEM analysts to conduct more accurate offshore oil and gas risk analyses.

Information on seafloor invertebrate species and abundances in the vicinity of existing federal platforms in the Pacific OCS is outdated and was last collected over 17 years ago. Recent work by the Southern California Coastal Water Research Project (SCCWRP) shows that the southern California seafloor is a patchwork of distinct biogeographic communities that separate generally by depth, resulting in infauna communities around federal platforms that differ depending on their depth. SCCWRP's last four regional sampling efforts have focused analyses and reporting on shallower areas and therefore have not fully described these biogeographic differences in deeper waters. An improved understanding of what is "normal" or considered unimpacted habitat at these different depths is the first step in assessing the cumulative seafloor impacts from oil and gas development. The proposed study *Disturbance Index Development for the Pacific OCS* will develop indices to assess and rank the degree of anthropogenic disturbance for outer shelf and slope soft-sediment biological communities in areas surrounding platforms in the southern California OCS.

Habitat and Ecology

Information on seafloor invertebrate species and abundances in the vicinity of existing federal platforms in the Pacific OCS is outdated and was last collected over 17 years ago. Recent work by the SCCWRP shows that the southern California seafloor is a patchwork of distinct biogeographic communities that separate generally by depth, resulting in infauna communities around federal platforms that differ depending on their depth. SCCWRP's last four regional sampling efforts have focused analyses and reporting on shallower areas and therefore have not fully described these biogeographic differences in deeper waters. An improved understanding of what is "normal" or considered unimpacted habitat at these different depths is the first step in assessing the cumulative seafloor impacts from oil and gas development. The proposed study *Disturbance Index Development for the Pacific OCS* will develop indices to assess and rank the

degree of anthropogenic disturbance for outer shelf and slope soft-sediment biological communities in areas surrounding platforms in the southern California OCS.

Energy projects typically have a long lifespan and require evaluation of impacts across several decades. In particular, BOEM needs to be able to project and analyze the potential for large environmental changes affecting resources also potentially impacted by offshore energy projects. Sea-level rise is one of the large changes expected to significantly impact our coastline over the next several decades that needs to be considered in our environmental reviews. Site-specific information addressing the expected/predicted changes from sea-level rise is not available. The predictive sea-level rise information that currently exists for coasts is either focused on the human environment or is at a large landscape scale and is not conducive to a BOEM-scale NEPA analyses. The proposed study *Predicting Species Distribution and Habitat Alteration Based on Sea-level Rise* will produce a predictive tool for evaluating changes to species patterns and habitats based on sea-level rise for coasts adjacent to OCS energy projects.

BOEM has collected two decades of rocky intertidal data adjacent to Pacific OCS oil and gas operations. However, some remote southern California sites that could be affected by an oil spill cannot be physically characterized. Through our coordination of the Multi-Agency Rocky Intertidal Network (MARINe), BOEM now has sufficient information to allow extrapolation to, rather than actual observation of, remote sections of the coastline, provided certain other information about the habitat has been collected. The proposed study *Baseline Characterization of Unsurveyed Southern California Rocky Intertidal Communities* builds on the BOEM-MARINe study by adding a tool that allows for a broader assessment of impacts to rocky intertidal communities in the event of an OCS oil spill. The data collected and products generated will augment information for BOEM scientists and planners about locations of the rarest and most sensitive biological communities in rocky intertidal zones and provide greater detail to habitat maps used for spill response.

5.3 Renewable Energy Science Strategy

The Pacific OCS relies on information to regulate future renewable energy projects that may be proposed and implemented in the Pacific Region. There is both interest and resource potential for deepwater wind and wave energy facilities along the entire U.S. West Coast and offshore Hawaii (Figures 5.2 and 5.3). For more information about the Pacific OCS Region's renewable energy program, please visit http://www.boem.gov/Pacific-Region-Renewable-Energy/.

Leasing and permitting OCS renewable energy development, permitting power cables on the OCS associated with renewable energy, and permitting repurposing of OCS facilities will involve new environmental considerations and, consequently, additional environmental studies. BOEM Pacific Region must acquire information from studies to inform decisions on existing and prospective lease applications for renewable energy and gather this information for the OCS of Oregon, the Hawaiian island of Oahu, and south central and northern California and include information on the risks inherent to those activities (e.g., bird and/or marine mammal collisions and fisheries exclusion). Near-term decisions include those associated with leasing, shore construction, offshore installation, operations, and maintenance of both floating turbines and wave energy conversion devices off Oregon and Hawaii and starting discussion and considerations with the State of California.

The goals and objectives of the Pacific Region science strategy for renewable energy are:

➢ Goal 1: Continue to acquire and synthesize baseline information on species and habitats
        Objectives:
- Synthesize and analyze existing long-term species data sets
- Continue ecosystem surveys for protected species

➢ Goal 2: Facilitate consideration of renewable energy goals with California
        Objective:
- Delineate the supply and demand for California renewable energy

➢ Goal 3: Track local community perceptions as renewable energy development occurs
        Objective:
- Describe the use patterns and views before and after WindFloat Pacific

Proposed studies in support of these objectives are described below.

Habitat and Ecology

Renewable energy projects on the OCS of Oregon are offshore of existing seabird colonies and could potentially have effects on seabirds breeding within the Oregon Coast National Wildlife Refuge Complex and Washington Maritime National Wildlife Refuge Complex. In order to address these potential effects, BOEM needs to process, analyze, and summarize long-term seabird colony abundance and distribution data collected by USFWS and to produce products available for use in impacts assessments under NEPA. Such information would provide an environmental baseline against which to evaluate potential effects of region-wide offshore energy development projects on West Coast seabird breeding colonies and populations. The proposed study *Analysis of Long-term Seabird Colony Legacy Data in the Pacific Northwest as a Regional Baseline* would enable comparisons of bird attendance between colonies and project sites before and after project installation, and provide the baseline information in a manageable database.

Information Management

California's ambitious plans for renewable energy under the Renewables Portfolio Standard program require investor-owned utilities, electric service providers, and community choice aggregators to increase renewable energy resources to 50% of total procurement by 2030. BOEM must start discussion and considerations with the State of California as soon as possible. Responsible preparation for marine renewable energy development on the OCS of California requires: 1) an understanding of the regional need for power generation; 2) delineation of feasible scenarios of offshore wind and wave energy projects for a specific planning area; 3) consideration of compatible activities that may arise; and 4) the ability to understand, evaluate, predict, and monitor potential adverse impacts. The proposed study *Scenarios for Replacing Conventional Energy with Offshore Renewable Energy along the Central California Coast* will aid BOEM in planning for leasing decisions, site and impact characterization, identification of cooperating agencies, and stakeholder outreach.

Marine Mammals and Protected Species

BOEM is tasked with conducting detailed environmental analyses of proposed renewable energy projects that include evaluation of potential direct, indirect, and cumulative impacts on the marine environment, including protected species of marine mammals and seabirds. BOEM provided partial support for a 2014 survey that included fine-scale data collection in two offshore Oregon areas of special interest to BOEM: the Pacific Marine Energy Center-South Energy Test Site (PMEC-SETS) and the WindFloat Pacific site, in addition to the standard survey grid (U.S.-Mexico border to U.S.-Canada border and seaward to 300 nautical miles). The proposed study *California Current Cetacean and Ecosystem Assessment Survey and Use of Data to Produce and Validate Cetacean and Seabird Density Maps* will repeat the 2014 survey in 2016 in order to provide a second survey of the marine mammal and seabird communities located within the specific sites and within the greater California Current, in a manner that is consistent with previous and ongoing large-scale studies of these species by NOAA. The study will produce density maps of protected species using a habitat-based spatial modeling framework.

Social and Economic Sciences

The WindFloat Pacific project is on track to be the first offshore wind project in federal waters off the West Coast and the first full-scale project in the nation to use a floating structure to support offshore wind generation in the OCS. The project provides a unique opportunity to gather observational data before and after the project is installed and operational, especially for socioeconomic resources such as recreation, tourism, and community perspectives. Information about how behavior and perspectives toward these resources change before and after an offshore renewable energy installation is entirely lacking in the U.S. because of the lack of installations. The proposed study *Recreation, Tourism, and Community Perspectives in Southern Oregon Before and After Offshore Wind Development* would acquire these valuable data, which are needed for NEPA analyses for WindFloat and other future West Coast offshore renewable energy projects. This information could also contribute to West Coast marine spatial planning efforts, provide additional information for the BOEM Oregon Renewable Energy Task Force, and assist coastal planners in Oregon.

Tables of proposed studies for the Pacific Region are included in Appendix I. Profiles for these proposed studies are provided in Appendix II.

5.4   Future Plans

This section presents a general discussion of issues that the Pacific Region anticipates may be of interest in the future. The Pacific Region has a challenging and multifaceted mission, and must assess impacts from two vastly different types of offshore energy development (conventional and renewable) and three different technologies (oil and gas production, marine hydrokinetic (MHK) wave energy conversion, and wind energy conversion) over a broad geographic area that includes the OCS off four states (California, Oregon, Washington, and Hawaii). Information needs vary greatly between the different energy programs, technologies, and geographic areas, necessitating imperfect foresight to maximize the benefits of future studies. Additionally, the offshore energy sector, both conventional and renewable, is volatile in the Pacific Region, and circumstances require flexibility to quickly change the scientific endeavor and/or location of the

needed information. BOEM Pacific Region has chosen to be responsive to federal agencies, state, and industry interests whenever and wherever that interest in a task force or lease application arises for renewable energy offshore Oregon, California, and Hawaii. For conventional energy, California has the sole interest.

5.4.1 Conventional Energy Future Plans

Ongoing activities related to oil and gas production, and the potential for oil spills close to the coast, will continue to be important for Pacific studies, and this interest will only increase as industry inevitably moves toward decommissioning OCS facilities. Consideration will be given to the review of oil and gas-related studies, some of which are several decades old, and to determining the need for updating that information. The Region will soon need studies specific to southern California fish, fisheries, birds, toxicology, physical oceanography, and marine mammals prior to decommissioning. A proposed study in this SDP will expand regional oil spill modeling to consider the transport of oil and its by-products below the surface, into both the water column and the sediments. Another proposed study seeks to examine biological and oceanographic connectivity between the platforms and the Santa Barbara Channel ecosystem. Additional studies of this type will be pursued in the future.

5.4.2 Renewable Energy Future Plans

Major subject topics, such as socioeconomic considerations and potential impacts to benthos, seabirds, or fisheries vary greatly between renewable energy technologies and between geographic areas, especially between Hawaii and the U.S. West Coast, where there is increasing interest in OCS wind and wave energy. The Pacific Region's information needs focus on information exchange, baseline and impact studies, and data management, integration, and synthesis. Since no single federal, state, or academic institution will be able to provide all of the needed information, it will be important for BOEM to foster partnerships, where possible.

While there is no regional socioeconomist on staff, efforts to garner urgently needed information are underway through collaborations with other federal agencies, researchers, and stakeholders, including regionally and ESP-funded studies to project visual impacts of offshore renewable energy technologies and identify submerged and coastal cultural resources, patterns of human uses of the ocean, and implications of renewable energy development. Additionally, a new study proposed in this SDP aims to gather recreation and tourism trends and public perceptions before and after the installation of floating wind turbines off Oregon. The Region recognizes the importance of integrating natural and social sciences in planning and decision-making for offshore energy; nonetheless, the Region has limited staff and no dedicated socioeconomic specialist. It is unknown when the Region may be able to fill this staffing need.

The collection of baseline data prior to commercial development will turn toward site-specific assessment, which will rely on industry interest and applications. Until recently, interest in wave energy development was limited to a few shallow-water sites off Oregon. However, interest in both wave and wind energy off Oregon and Hawaii has accelerated and expanded to include multiple OCS sites in water depths of 100-1000 meters. Additionally, the Governor of California is intensifying enlarging the state's energy portfolio to include renewable energy from the OCS.

As a result of this expanding interest, Pacific studies will need to address multiple and disparate ecosystems.

5.4.3 Marine Minerals Future Plans

Although no studies specific to Pacific OCS marine mineral resources are ongoing or proposed in this SDP, there may be future information needs (including the need for environmental studies) as extraction methods and economic conditions improve and opportunities to explore and extract those resources become increasingly attractive to developers. Over the past five years, winter storms and high tides have stripped many southern California beaches of sand. Unfortunately, natural replenishment has not occurred in large part due to a long-term state-wide drought. In the past California has relied on rainfall to carry sediment out to coastal waters, where it settles back on the shoreline. As a consequence, the California Natural Resources Agency re-initiated discussion with BOEM in 2014 regarding potential sand resource leases.

The Pacific Region will remain responsive to the interest expressed by the State of California whenever and wherever they have a need for sand resources to replenish eroded beaches. A study to determine the characteristics of an OCS sand burrow off Ocean Beach (near San Francisco) was considered in 2007. That study may be reconsidered in the near future.

5.4.4 Stakeholder Outreach and Partnerships Future Plans

For the past several years, the Pacific Region has reached out to major stakeholders in all four states for their thoughts and ideas on the direction of Pacific renewable energy studies. This effort has been accomplished through formal letters. The process was successful for the first few years; however for this FY 2016-2017 SDP, BOEM Headquarters took the lead and sent an email to over 7,000 stakeholders (groups and individuals) soliciting research ideas. The best ideas for needed information and consequent study design should come from the BOEM analysts and policy makers who are actually performing the environmental project reviews, writing the NEPA documents, and making the decisions. Stakeholders often have a refreshing outlook and may identify ecosystem resources or ecological connections that complement BOEM's ideas. In the future, rather than soliciting simply for any and all stakeholder ideas, BOEM Pacific Region may identify broad topics of interest to the Region and ask for study ideas that specifically address those topics. BOEM Pacific Region intends to continue and deepen our existing partnerships across all federal and state agencies, non-governmental organizations, and industry for both conventional and renewable energy programs. This effort includes sincerity in funds and/or in-kind matching of staff, equipment, supplies, or services, or transportation and access to industry facilities. In FY 2014 the Pacific Region met with California Sea Grant, Hawaiian Islands Humpback Whale National Marine Sanctuary, USFWS, USGS, Department of Energy (DOE), and NOAA West Coast and Hawaii science centers. BOEM Pacific Region looks forward to expanding this effort in the future and possibly working toward regional ecosystem science conferences, especially for California and Hawaii.

CHAPTER 6   ATLANTIC STUDIES

6.1   Introduction

The Atlantic OCS extends from Maine to Florida and is divided into four planning areas (Figure 6.1). The OCS planning areas extend from the State/Federal boundary at 3 nautical miles (nm) out to the outer boundary of the EEZ at approximately 200 nm. Although not by design, these planning areas roughly coincide with the LMEs along the Atlantic as defined by NOAA (see http://www.lme.noaa.gov/). On the Atlantic OCS, the Renewable Energy Program and Marine Minerals Program are actively managing leases, while the Conventional Energy Program is in the planning stages with proposed areas identified in the Mid- and South Atlantic (Figure 6.1). BOEM issued a Record of Decision (ROD) for G&G surveys in the Mid- and South Atlantic Planning areas. The decision addresses G& G activities in support of all three program areas (conventional, renewable energy and marine minerals) but does not authorize leasing for oil and gas exploration and development in the Atlantic.

6.1.1 Conventional Energy Program

Activity and interest are also increasing for offshore oil and gas exploration and development in the Atlantic OCS. BOEM recently issued its Draft Proposed Program (DPP) for the 2017-2022 OCS Oil and Gas Leasing Program, which includes an area encompassing offshore Virginia, North Carolina, South Carolina, and Georgia outside of a 50 mile buffer zone from shore (Figure 6.1). BOEM's Conventional Energy Program has been actively engaging with Federal and State agencies, regional councils, and a variety of stakeholders to provide information and to further evaluate studies and engagement needs. Most recently, BOEM held a series of Atlantic G&G outreach meetings to provide information on the G&G permitting process, mitigations for minimizing environmental impacts, and ongoing and developing environmental studies.

While a conventional-energy scenario has yet to be developed, BOEM needs to pro-actively consider potential impacts ranging from onshore communities to offshore waters, including from the coastal zone all the way out to the EEZ. Based on BOEM's Resource Assessments, a likely area of potential interest for Atlantic activity is in deeper waters of the OCS. In 2014, BOEM published an update to its 2011 assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Atlantic OCS (BOEM 2015c). This assessment update incorporated important new information from recent oil and gas discoveries considered analogous to selected geologic plays in the Atlantic OCS. As a result, this new analysis estimated a 43% increase in Atlantic undiscovered oil and a 20% increase in undiscovered gas in comparison to the 2011 assessment. While water depths in the geological plays range from less than 30 m to over 3,000 m, the 2011 assessment demonstrated that the vast majority of potential oil and gas resource is in water depths greater than 200 m, with significant potential resource also in the >800m water depth range.

6.1.2 Renewable Energy Program

The Office of Renewable Energy Programs (OREP) is responsible for implementing and managing the Atlantic's offshore renewable energy development, including leasing, leading

inter-governmental task forces, State consultations, and post-lease permitting in Federal waters off the East Coast (Figure 6.2). The focus of the program is currently for wind and marine hydrokinetic (wave, current) projects.

OREP has established inter-governmental task forces to coordinate and collaborate with affected State, local, and Tribal governments, and relevant Federal agencies, concerning renewable energy commercial development activities along the Atlantic coast. These efforts enable BOEM to further identify and address any major challenges regarding the issuing of commercial leases for renewable energy generation by increasing the Bureau's visibility and accessibility to major stakeholders. Task forces have also been formed in eleven Atlantic coastal states, and task force meetings allow stakeholders early input into the planning process by identifying potential areas of space-use or environmental conflicts.
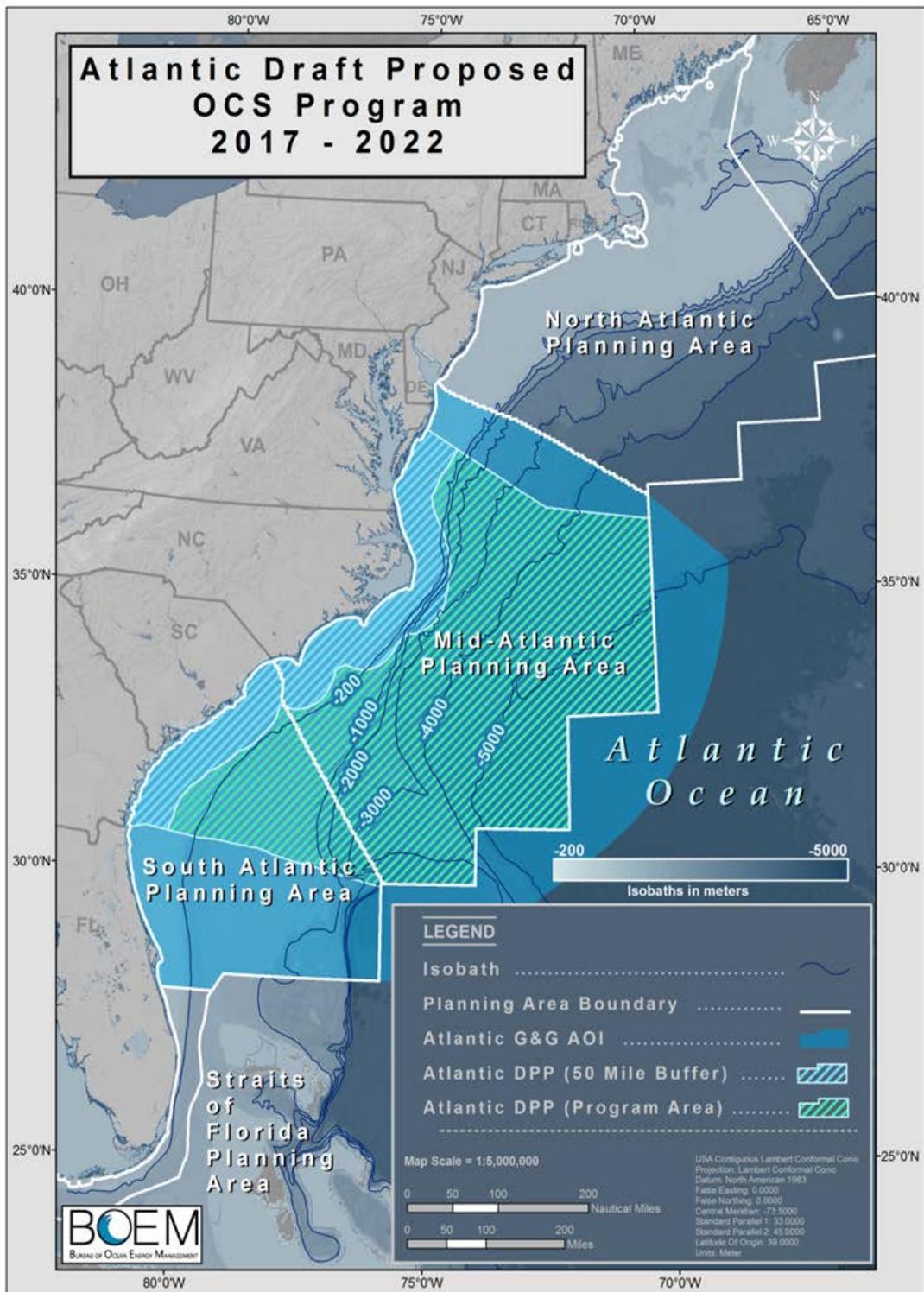
Figure 6.1. Atlantic OCS Region Planning Areas and 2017-2022 DPP Program Area for OCS Oil and Gas Leasing.
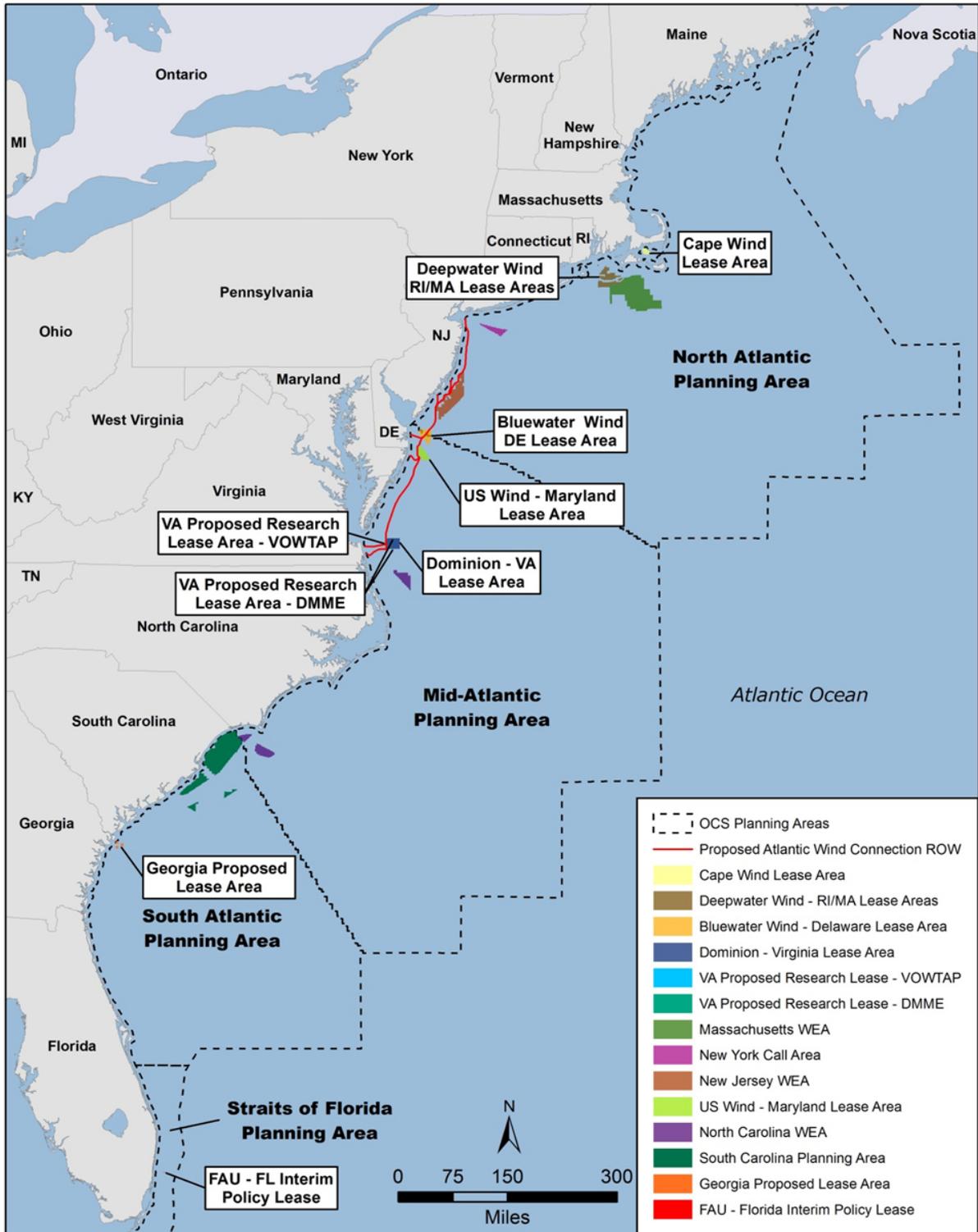
Figure 6.2. Atlantic OCS Planning Areas for Renewable Energy.

6.1.3 Marine Minerals Program

Hurricane Sandy response efforts have focused on a more proactive regional approach to building coastal resilience in the Atlantic rather than addressing sand renourishment needs at the individual project scale. Hurricane Sandy damage (Figure 6.3) also triggered a wide range of emergency management initiatives along the entire Atlantic coast, such as multiple USACE coastal storm risk management projects. These Federal projects necessitate OCS sediment resources to support their short- and long-term needs and require MMP authorization before proceeding. Additionally, a large number of non-Federal beach nourishment project sponsors continue to pursue Atlantic OCS sand resources for their locally-funded efforts. In support of regional partnerships in the Atlantic region, the MMP participates in the NROC, MARCO, the Governor's South Atlantic Alliance (GSAA), and other organizations supporting regional initiatives that identify and prioritize sand resource needs. Currently, BOEM is undertaking efforts along the Atlantic coast to identify potential new sand resources through 13 state Cooperative Agreements (COOPs) and a contract to acquire geophysical and geological data from Maine to Miami, FL. Coupled with ongoing environmental monitoring initiatives, these efforts will facilitate a regional sediment resource management perspective and support "smart" borrow area optimization decisions.

Figure 6.3. Before and After Hurricane Sandy Storm Damages (Seaside Heights, NJ).

Following Hurricane Sandy, MMP utilized approximately $2.35 million in Disaster Relief Appropriations Act (DRAA) funds to support two collaborative studies with the National Aeronautics and Space Administration (NASA), the University of Florida (UF), the Navy, and USACE to investigate the long-term recovery of benthic and fish communities following the dredging of a borrow area offshore central Florida at Canaveral Shoals. In addition, the ESP has supported further efforts in both of these studies to expand the fish surveys and continue this monitoring into the long-term. The comprehensive nature of these collaborative studies is the first of its kind in evaluating dredging impacts within offshore shoal habitats. These studies are

ongoing, and initial data sets are providing valuable information on resident and transient fish communities and their habitat use pre-and post-dredging.

6.2 Conventional Energy Science Strategy

BOEM will expand upon the important baseline and monitoring programs that have been performed over the decades on the Atlantic OCS and provide benchmarks for assessing potentially changing environmental and socioeconomic conditions. The early history of Atlantic OCS research encompassed several large-scale benchmark studies. These were comprehensive pre-development studies that acquired baseline data for the geochemistry, biology, and physical oceanography of the region. In the 1980s, another set of interdisciplinary baseline studies was performed for the Atlantic Continental Slope and Rise (ACSAR). Protected species have also been the focus of several important studies over the years, including the Cetacean and Turtle Assessment Program (CETAP) in the late 70's and early 80's, which helped define critical habitat for the North Atlantic Right Whale. All of these studies and more provide an important context for the development of new Atlantic conventional energy-related studies and the assessment of potential impacts from development moving forward.

Air Quality

Since oil and gas exploration, development, and production are proposed activities in the Atlantic Region, BOEM has a unique opportunity for baseline monitoring before oil and gas activities are conducted. Thus, a study profile has been proposed for FY 2016 looking at baseline monitoring. *Atlantic Deepwater Ecosystem Observatory Network Study* (ADEON) proposes an integrated system for long-term monitoring of ecological and human factors on the OCS, including measurements of ocean currents, water quality, meteorology, and pollutants. It is important to learn baseline pollutant concentrations pre-oil and gas activities, which can be used as inputs into a photochemical model as background concentrations during the impacts analysis. Plus, subtracting this baseline pre-activities monitoring values to any future post-activities monitoring value will allow for a direct impact assessment.

BOEM has proposed another air quality study for FY 2016 for the Atlantic Region to determine if the potential 5-Year Multisale EIS Scenario OCS sources could significantly impact the onshore air quality of the Atlantic Region. *Air Quality Modeling for the Atlantic Region Study* will calculate potential offshore OCS emissions, run WRF meteorological modeling, and conduct photochemical modeling needed for the Atlantic Region to assess the OCS oil and gas development impacts to the states, if any, as required under OCSLA. The modeling results will be used by BOEM in the NEPA EIS impact analysis to support compliance with OCSLA.

Fates and Effects

Development of appropriate probabilistic estimates of oil spill occurrences is an important aspect of BOEM's oil spill risk analysis methodology. As a frontier region, there is no existing offshore development on the Atlantic OCS, and it will not be possible to base these oil spill probability estimates on empirical data from the region. Thus, the following new study proposed for FY 2016 will develop defensible probabilistic estimates of oil spill occurrences: *Alternative Oil Spill Occurrence Estimators for the Atlantic Ocean – Fault Tree Method.*

Similar studies employing fault tree methodology have also been employed in the Alaska region due also to the limited offshore development in that area. For this Atlantic study, statistically significant non-Atlantic empirical data from the US Gulf of Mexico (GOM) and world-wide sources, together with their variance, will be used as a starting point. Next, both the historical non-Atlantic frequency distributions and spill causal distributions will be modified to reflect specific effects of an Atlantic setting, and the resultant fault tree model will be evaluated using Monte Carlo simulation to adequately characterize uncertainties treated as probability distribution inputs to the fault tree. It is important that these new oil spill occurrence rates for the Atlantic region are determined as soon as possible, because they are one of the necessary inputs into BOEM's OSRA modeling. Specifically, the oil spill rates are incorporated into the calculation of "combined" oil spill probabilities from OSRA, which also takes into account spill trajectories, environmental resources, and the most likely oil and gas development scenarios for the region.

Habitat and Ecology

Establishment of long-term environmental monitoring assets in Atlantic deep waters is a high-priority need related to potential conventional energy activities. The Atlantic shelf/slope break is known to be a very productive area for a variety of species including squid, tunas, swordfish, marine mammals, sea turtles, and seabirds in addition to diverse bottom-dwelling fauna. However, the majority of measurements are sparse in deep waters and limited to one or two seasons per year (e.g., ship-based fisheries surveys). The observatory will be part of the new generation of "biological" ocean observing systems which can provide long-term measurements and well complement existing surveys. For FY 2017, the establishment of an *Atlantic Deepwater Observatory Network (ADEON)* study is proposed in the Mid- and South Atlantic to provide baseline measurements and environmental monitoring capabilities across multiple disciplines. In terms of biology, the network would provide information on prey (e.g., plankton), fish, and marine mammal distributions and habitat use, as well as soundscape, information required for EFH and ESA consultations, in addition to MMPA Rulemaking. Mooring sensors would employ bio-sensors based on optical and acoustic methods, such as high-resolution imaging and sonar systems, echosounders, and passive acoustic receivers/monitoring for animal tags and vocalizations.

Knowledge of the distribution of sensitive benthic biological habitats on the shelf and in deep water is necessary for management of potential oil and gas development in the Atlantic region. Such information is needed to define mitigations and avoid impacts to sensitive benthic habitats such as hardbottom areas and coral communities. A variety of sensitive deepwater habitats have been discovered in the Mid- and South Atlantic OCS, including deepwater coral communities and hardbottom that support important demersal fish species such as the snapper-grouper complex. While the area south of Cape Hatteras contains some of the most substantial deepwater coral habitat in U.S. waters, the vast majority of this region remains unexplored and unmapped by modern acoustic or seismic techniques. To efficiently and effectively map and explore sensitive benthic habitats over a region as vast as the Mid/South Atlantic OCS, it is necessary to develop the best possible predictive models of deepwater coral and hardbottom, and use those models to prioritize mapping and exploration. NOAA's National Centers for Coastal Ocean Science (NCCOS) has the demonstrated capabilities to perform this synthesis and modeling work, which is proposed in this SDP in the *Data Synthesis and Advanced*

Predictive Modeling of Deep Coral and Hardbottom Habitats in the Southeast Atlantic study profile.

Cumulative impacts analyses under NEPA have always proven challenging, and improved methods are required for understanding the range of potential impacts on Atlantic fisheries, including from potential oil and gas development. There are a variety of stressors that can impact fisheries, including overexploitation, climate change, habitat destruction, pollution, non-native species, and industrial development. For example, there is a new online tool "OceanAdapt" which tracks fish populations as climate changes and shows resulting changes to habitat usage by numerous species in the Atlantic. Advanced modeling is a useful tool for capturing potential impacts from multiple stressors on fisheries, and NOAA's Atlantis Ecosystem Modeling System provides such a capability. The following new study for FY 2017 is proposed to better quantify cumulative impacts on Atlantic fisheries: *Development of an Atlantis Model for the Mid- and South Atlantic OCS to Facilitate Strategic Planning and Cumulative Impact Evaluation*. This study will develop a functioning Atlantis Biophysical Model for the region of interest and will explore the potential impacts of ocean energy resource utilization and other stressors on key fisheries, protected species, and essential fish habitat.

Information Management

Up-to-date information on current research and available datasets for the Mid- and South Atlantic is required by BOEM analysts across disciplines. A new synthesis of best available science will help subject-matter-experts fulfill their obligations under NEPA and the other laws the agency adheres to, in order to provide management with a sound basis for decision making. Information Transfer Meetings (ITMs) have historically provided the agency with an important forum for Principal Investigators on BOEM studies to provide the latest results of their research and to develop collaborations across studies. The last workshop related to the Atlantic was the 2008 "Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities".

Thus, it is timely to conduct the next Atlantic ITM to more broadly inform potential oil and gas development on the Mid and South Atlantic OCS, bringing together experts from across subject areas to provide a synthesis of the current state of knowledge. The following new proposed study will accomplish these goals: *Information Transfer Meeting to Understand the Past and Current Status of Human and Environmental Resources for the Atlantic OCS*. In addition to expert presentations at the workshop, this study will also provide for an updated literature synthesis and GIS maps and shapefiles for use by SMEs.

6.3   Renewable Energy Science Strategy

Avian Species

The potential effects of offshore wind development on avian species and the overall negative impacts on avian populations have been a concern since the first proposal to build an offshore wind facility. Although an individual project may trigger many environmental concerns, most concerns related to avian resources tend to extend beyond the relatively small foot print of an

individual project. For this reason, BOEM's avian research efforts for the Atlantic OCS are focused on identifying areas where Atlantic offshore wind energy development is least likely to negatively impact avian populations at the regional scale. In addition, information obtained from implementing this strategy will be used to inform BOEM's NEPA process, provide pre-construction baseline data for post-construction impact assessments, and provide information for the design of future studies and guideline development.

BOEM's avian research strategy centers on developing a regional understanding of the distribution and abundance of avian species that are potentially vulnerable to offshore wind energy development on the OCS. BOEM's avian research strategy also includes the identification of the migratory corridors used by vulnerable avian species that may intersect with potential wind energy areas.

Implementation:

1. Identify areas where avian species may be vulnerable to renewable energy development:

    a. The Compendium of Avian Occurrence (IA with USGS). A compilation of bird observations dating back to 1907 to document historic distribution patterns of birds on the Atlantic OCS. This effort is ongoing with new datasets including the data from the New Jersey Ecological Baseline Study, Rhode Island Special Area Management Plan, Atlantic Marine Assessment Program for Protected Species, and others. We propose to continue this effort for the next five years, including developing a website for data discovery and access.

    b. Recent (since 2005) and current avian survey locations on the OCS (BOEM). (http://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Mapping_and_Data/ATL_WILDLIFE_SURVEYS.zip) On-going data collection efforts include Surveying for Marine Birds in the Northwest Atlantic (IA with USFWS), AMAPPS (IA with NOAA), the BRI Baseline Ecological Survey of the Mid-Atlantic (DOE funded study developed with BOEM), plus efforts conducted by different states that are funded in part with cooperative agreements with BOEM. These efforts use a combination of survey methodologies including boat surveys and traditional and hi-definition aerial surveys. The surveys will be extended into the South Atlantic during FY2014.

    c. Predictive Mapping of Seabird Distribution and Abundance on the Atlantic OCS (IA with NOAA started in 2013). Development of statistical models using data from Compendium of Avian Occurrence and environmental variable to create continuous maps that predict avian occurrence and abundance on the OCS. The seabird distributions will be compared to the movements of fishing vessels and commercial ships.

    d. Statistical Analysis to Support Guidelines for Marine Avian Sampling (IA with NOAA completed in 2012). A general method for estimating the number of avian surveys needed to detect avian hot and cold spots on the Atlantic OCS.

e. Assess Relative Vulnerability of Migratory Bird Species to Offshore Renewable Energy. This study compiles species-specific data, calculates vulnerability indices to collision and displacement for some 200 avian species that use the Atlantic OCS.

f. Developing new technologies for surveying on the OCS including hi-definition aerial imagery and acoustic/thermographic systems.

2. Identify migratory corridors that may intersect potential wind development sites:

a. Offshore Use of Diving Marine Birds Using Satellite Telemetry (partnering with USFWS). Birds that are being studied include long-tailed ducks, northern gannets, surf scoters, and red-throated loons. The study was extended for an additional year of tagging to improve the statistical analysis for the fall migration.

b. Tracking Offshore Occurrence of Common Terns and American Oystercatchers (partnering with USFWS). The study completed the first two years with successful results for terns and oystercatchers. The study will be expanded in 2015 to include tagging of the endangered roseate tern and threatened piping plover.

Habitat and Ecology

The effects of renewable energy development on fish and fisheries range from modification of the seafloor habitat to displacement of fisheries from the site of a wind facility. Fundamental to protecting fish species and fisheries is an understanding of the habitat, particularly on the scales of the wind facility and the wind energy areas identified for leasing. Through the study *Fishery Physical Habitat and Epibenthic Invertebrate Baseline Data Collection*, BOEM is collecting baseline information about seafloor habitats and creating maps from these collections in partnership with NOAA. This information will form the basis for understanding the seafloor habitats prior to offshore wind development and may be used for comparison of changes post development.

Evaluating the economic effects of displacement of fisheries by wind facilities is currently underway through *Socio-Economic Impact of OCS Wind Development on Fishing*, which is being conducted by NOAA. The study is taking an initial look at the potential economic consequences of offshore wind development on fisheries along the Mid-Atlantic.

Of critical importance is the effect of wind facilities on listed species such as the endangered Atlantic sturgeon. Tagging sturgeon and using an existing network of receivers is a first step in understanding the interactions of this protected species with wind facility development through the study *Endangered Atlantic Sturgeon Habitat Use in Mid-Atlantic Wind Energy Areas*.

Cultural Studies

Section 106 of the NHPA requires Federal agencies to consider the effects of their activities on historic properties. Historic properties are defined as any site, building, structure or object,

included in, or eligible for listing in, the National Register of Historic Places, including properties of traditional religious and cultural importance to Indian tribes.

Renewable energy activities have the potential to affect historic properties through the destruction or alteration of properties that are located on or below the seafloor or below ground in areas where transmission components come ashore, and also through the introduction of visual elements that may impact onshore historic properties. OREP relies on the environmental studies program to provide research that directly and relevantly informs the Bureau's compliance responsibilities under the NHPA for renewable energy activities on the Atlantic OCS.

Studies do not replace the compliance process, rather they are developed to fill data gaps or provide additional information that is applied to how the bureau conducts its compliance with the NHPA and how this process is efficiently coordinated with the Agency's regulatory functions. To that end, cultural resource studies are organized around the following framework that is keyed to the steps of the Section 106 process:

Consultation: These are studies that provide additional tools or opportunities for engagement and information sharing with academics, stakeholders, and others.

Identification of historic properties: These include studies designed to test the effectiveness of existing identification methods, studies that are designed to test new approaches to identification efforts, studies that provide baseline information, and studies that provide tools for managing information related to the identification of historic properties. These studies all provide feedback into the guidance BOEM provides to developers.

Vibracore collection is a method that is unique with respect to its utility to assist in the identification of submerged archaeological sites on the OCS that once existed as dry land but are now submerged as a result of sea level rise. Application of this technology to identifying these archaeological sites is still in its infancy. BOEM has a need for standards and best practices regarding the adequate collection and appropriate laboratory analysis of vibracores as a method for aiding in the identification of historic properties offshore the Atlantic.

Considering impacts: These include studies to better understand the impacts renewable energy projects may have on historic properties and studies that consider approaches to mitigate or avoid these effects.

6.4   Marine Minerals Science Strategy

The MMP is sponsoring environmental monitoring initiatives to better understand potential environmental impacts and more proactively manage dredging activities; this also furthers the goal of streamlining access to OCS sand resources. In order to leverage cost effective/mutual interest research opportunities, the MMP staff collaborates with coastal states, federal agencies, and academia on regional and project-specific environmental and resource evaluation research. Cooperative agreements have been developed with state agencies and universities to better understand environmental impacts and identify and manage sand resources in areas where sand is more replete.

Fates and Effects

The MMP is currently working with the UF, the U.S. Navy and NASA (in cooperation with USACE and Brevard County, FL) to evaluate the use and ecological recovery of Canaveral Shoals II (an OCS sand shoal/borrow area) by various resident and transient fishes along with their prey. This study leverages funding and mutual interests of the UF and the U.S. Navy. The U.S. Navy and NASA have a large amount of existing data on fish movements offshore Cape Canaveral. Both agencies are integrating historical data with newly acquired data from tagging efforts on lemon sharks and scalloped hammerhead sharks. BOEM is adding 26 receivers to the 200+ existing receivers in the Florida Atlantic Telemetry Group (FACT) array (maintained by 6 universities, 4 state or federal governments, 5 non-profits, and 1 private group). In addition, the ESP has supported further efforts to expand ongoing fish surveys and continue the monitoring into the long-term. The comprehensive nature of these collaborative studies is the first of its kind in evaluating dredging impacts within offshore shoal habitats. Initial data sets are providing valuable information on resident and transient fish communities and their habitat use pre-and post-dredging. In collaboration with the Navy and NASA, the MMP is proposing additional FY 16-18 investments to compliment this long term study through the addition of glider-based fish tracking technologies. The use of a wave glider will significantly increase the utility of the data obtained from BOEM's pre-existing project infrastructure (i.e. acoustic arrays, existing tagged fish, developed eco-path models, etc.). Specifically, the wave-glider will receive acoustic data from the tagged fishes outside of the current footprint of the stationary acoustic arrays; thus, supporting a more comprehensive assessment of how the shoal habitat is used by resident fish populations. These fine scale data sets associated with the habitat utilization by managed fish species within Canaveral Shoals will significantly improve EFH assessments of dredging activities within sand shoal habitats and inform continued refinement of proposed dredging mitigation measures to minimize ecological impacts.

Information Management and Data Sharing

BOEM's current cooperative agreements with 13 states along the Atlantic, coupled with the execution of the data collection efforts under the Atlantic Sand Assessment Project (ASAP), promote data sharing across state boundaries. These efforts will also help to develop regional and national perspectives and strategies for identifying sand resources available for coastal projects. Upon completion of developing this regional framework of OCS sand resources, MMP will be positioned to assess the long-term cumulative footprint of dredging activities relative to geomorphologic features and associated habitat types.

The MMP hosts regional SMWG throughout the Atlantic and states to encourage discussion about past, ongoing, and future projects, potential environmental concerns, study needs, and lessons learned. The MMP is also an active participant in Atlantic regional planning groups such as the NROC and MARCO and shares information and identifies data and study needs.

6.5 Cross-Program Science Strategy

Characterization of marine mammal, bird, and protected species distributions, abundance, and habitat use information is an ongoing critical need across BOEM's Atlantic program areas. Anthropogenic sound and its potential impacts on marine mammals is an especially important

topic, given the multiple G&G permits for the Atlantic currently being reviewed by the Bureau. BOEM works closely with BSEE and NOAA NMFS to ensure that appropriate mitigations are in place to minimize impacts on protected species, as required by the Endangered Species Act.

BOEM continues to support surveys for marine mammals in collaboration with NOAA. Besides traditional boat and aerial surveys, BOEM is supporting passive acoustic monitoring studies, which have the ability to collect data continuously in specific locations and enable the evaluation of migratory movement both spatially and temporally. BOEM is supporting an increasing number of recorders that are (or will be) simultaneously collecting data offshore the Carolinas, Virginia, Maryland, and Massachusetts. This effort joins other efforts along the Atlantic Coast by NOAA and the U.S. Navy.

An ongoing study of especial importance is the *Atlantic Marine Assessment Program for Protected Species* (AMAPPS), now in its second phase of funding. The primary goal of the study is to provide broad-scale surveys of the distribution and abundance of protected species from the near shore all the way out to the EEZ. In its second phase, the study will continue to expand its tagging of Loggerhead sea turtles and marine mammals. Given knowledge gaps in deep waters, with especial relevance to conventional energy, this study will continue to collect crucial field observations out to the EEZ to inform spatial and temporal understanding of species distributions. The Atlantic Oil and Gas program recently added funds to the AMAPPS-II study to deploy several deepwater passive acoustic monitoring (PAM) stations along the shelf slope/break to monitor for deep diving whale activity, including for sperm whales, beaked whales, and melon-headed whales.

BOEM previously conducted the *Seismic Survey Mitigation Measures and Marine Mammal Observer Reports* study, which summarized and synthesized seismic survey observer reports for the years 2002 to 2008. The study also made recommendations as to the effectiveness of mitigation measures and suggestions for improved mitigations. A follow-on study has been proposed in the Gulf of Mexico Region SDP, which will perform the same analyses for more recent data from the Gulf and new data as it is collected in the Atlantic. The results of this study will be an important aspect of communicating with stakeholders the impacts of BOEM activities in the Atlantic and will feed directly into the adaptive management process.

Sediment mobility also leads to a redistribution of the local sedimentary layers, which in turn affects the distribution and abundance of benthic communities that are an integral part of the ecosystem. Understanding and predicting sediment dynamics as a result of the introduction of fixed facilities and dredging operations is an important aspect of the potential environmental consequences from offshore development.

Tables proposed studies for the Atlantic are included in Appendix I. Profiles for these proposed studies are provided in Appendix II.

6.6 FUTURE PLANS

6.6.1 Conventional Energy Future Plans

Baseline studies are an important part of the new Atlantic Oil and Gas studies initiative and will continue to be for several years to come. These baseline studies across a range of disciplines are performed by BOEM to meet its obligations under OCSLA which require pre-development environmental sampling against which to assess possible human-induced changes. Benchmark studies for the Atlantic have historically included measurements of geochemistry, biology, and physical oceanography, and will similarly be included in future Atlantic study plans, allowing for updated scientific methodologies, techniques, and sample collection. A proposed study for FY 2017 will provide a Baseline Geochemical Characterization of the Mid- and South Atlantic OCS to determine the current state of water and sediment quality. It is anticipated that ship time for this study will be leveraged with other baseline studies, such as benthic biology characterizations, tissue contaminant sampling, and physical oceanographic studies.

BOEM's OSRA modeling will require updated inputs of oceanographic and wind forcing fields. The OSRA modeling relies on state-of-the-art oceanographic modeling to provide 3D hindcasts (of 10 years or more) that are validated against actual field measurements. The main goal of the *Mid- and South Atlantic Ocean Modeling* study proposed for FY2017 is to identify a proven, data-assimilating ocean model for the Atlantic OCS that can provide reliable ocean currents, which are then used for calculating spill trajectories in the OSRA model. In recent years many improvements have been made in Mid- and South Atlantic Ocean models and a number of sensitivity calculations have been performed. This study will identify an appropriate model to perform hindcast simulations of ocean currents and winds, including validation with an extensive existing oceanographic dataset and possible improvements to existing physical model parameterizations (such as in deep waters).

BOEM is actively coordinating to develop its next major Atlantic Oil and Gas studies initiative for deepwater exploration and research on the Mid and South Atlantic OCS. The *Deepwater Atlantic Habitats II* study proposed for FY2017 represents a follow-on to the inter-agency Mid-Atlantic Canyons study which provided important new information on deep water communities, including discoveries related to *Lophelia* and methane chemosynthetic community distributions. With potential oil and gas activity on the Mid and South Atlantic OCS, BOEM now requires further deepwater information in an expanded footprint including further into the southeast Atlantic. Study results will help to define mitigations and need for avoidance of hard bottom areas and associated sensitive communities in deep water, including corals, canyons, and seep communities. This study will employ the successful paradigm for deep water research which has been established through inter-agency partnerships during several previous exploration programs, including the Mid-Atlantic Canyons Study. BOEM anticipates again involving partnerships with NOAA's Office of Exploration and Research (OER) and USGS, as we work together to achieve common goals related to understanding of deep water communities – their identification, biodiversity, ecology, and food web dynamics.

Future studies will address the potential socioeconomic consequences of offshore oil and gas development in the Atlantic as it unfolds. For example, one identified future study will help fulfill the Environmental Justice requirements of Executive Order 12898 as it pertains to the

Mid- and South Atlantic regions. This study has been proposed for FY2017 and is titled: *Environmental Justice (EJ) Baseline for the Mid- and South Atlantic Regions: Hazard-risk assessment of low-income minority coastal populations near existing and projected onshore oil and gas infrastructure*. The study will identify minority and low-income populations and their geographic proximity to currently existing and future onshore coastal infrastructure that would support OCS-related oil and gas exploration, development and production. Two BOEM studies would serve as guidance for the effort - 1) *Onshore Oil and Gas Infrastructure to Support Development in the Mid-Atlantic OCS Region* (OCS BOEM Report 2014-657*), and* 2) *Environmental Justice Considerations in Lafourche Parish, Louisiana* (OCS Study MMS 2003-038*).* The first is a fact book about existing and projected infrastructure needs for Atlantic oil and gas exploration, development and production. The second serves as an example of an excellent methodological approach for environmental justice analyses.

6.6.2 Renewable Energy Future Plans

BOEM's immediate information needs for the Atlantic OCS are related to renewable energy, focusing on information needed for upcoming leasing and reviews of construction and operation plans. Over the next few years, those needs will shift to gathering baseline information at a finer scale and for new areas, studying the potential impacts of commercial wind and ocean energy facilities, and incorporating lessons learned regarding mitigation measures and post-construction survey protocols.

Within the next 5-10 years, BOEM anticipates that there will be several "game changing" technological advances in offshore renewable energy development that will result in the expansion of the number of leasing areas and likewise information needs for siting these lease areas. First, assuming that the sub-sea backbone transmission system (the Atlantic Wind Connection project) is successful, there will likely be many requests for development outside of the Mid-Atlantic wind energy areas – this will happen because it will become economically feasible to develop beyond 30 miles of a land-based electrical substation. Second, floating turbine technology will have likely matured, making the expansion of offshore wind development into deeper waters technologically and economically feasible. Third, Ecosystem Based Management and Marine Planning will have matured providing new regional baseline information. As a consequence, there may be a reassessment of areas that were initially excluded during the delineation of the first Wind Energy Areas (WEAs). These technological advances (including unanticipated advances) point to the critical need to the collection, compilation, and update of region-wide baseline data, maps, and decision tools.

6.6.3 Marine Minerals Future Plans

Much of the geologic and environmental research focus for FY 16-18 will continue to stem from ongoing Hurricane Sandy initiatives, including the $5 million sand resource data acquisition effort along the Atlantic OCS from Maine to Miami, Florida. This research will provide: (1) a regional baseline for benthic habitat assessment and monitoring, (2) a basis to eliminate environmentally sensitive or resource poor areas from consideration, (3) information regarding previously unknown potential cultural resources requiring further study, and (4) regional bathymetry for physical oceanographic modeling and impact assessment. This new dataset will greatly improve our knowledge of the shallow Atlantic OCS (3-8 nautical miles offshore) shelf and shallow subsurface and undoubtedly frame future scientific investigations.

As previously discussed, Hurricane Sandy and BOEM Studies funding is being used to support a long-term monitoring effort to: (1) to quantify the unique functional ecosystem services of ridge-swale habitats in the South Atlantic Bight; (2) to determine the functional, biological services that are potentially compromised by dredging of sand from ridge-swale habitats and determine the degree of impact; and (3) to investigate the mechanisms of recovery of invertebrate and fish communities associated with ridge-swale habitats post-dredging. While the funding for this work is limited by current funding to three years, continued monitoring of this recovery through studies program funding for a total of 7-10 years would be invaluable.

Considering the comprehensive nature of this study, the robust study design, and the value of the study results received thus far, the MMP is interested in conducting a companion study effort within the Mid-Atlantic region (e.g. Wallops Island) considering the extensive OCS dredging that has occurred and will continue to occur in the offshore shoal complex. Additionally, the NMFS HCD has indicated interest in conducting a similar long term monitoring study in the Northeast region, within the vicinity of NJ, working in collaboration with the NMFS Sandy Hook, NJ field lab. This opportunity will be pursued further in FY 15/16 following additional coordination with the NMFS field lab. Following damages received from Hurricane Sandy, the emphasis on use of OCS sediment resources to support coastal resiliency projects throughout NJ continues to increase. Establishing baseline monitoring of benthic and fish community use within ridge swale habitats offshore of NJ coupled with long term post dredging recovery monitoring of pending borrow areas is critically important to support future borrow area management decisions.

6.6.4 Cross-program Future Plans

In upcoming years, adaptive management will play an important role in the Atlantic as BOEM assesses the effectiveness of mitigations that are in place for protecting marine life against the possible impacts of sound generated by G&G seismic operations. BOEM, BSEE, and NOAA NMFS will actively work together to be sure that mitigations are effective based on environmental datasets collected from seismic vessels. Passive acoustic monitoring and Protected Species Observations (PSO) datasets, which are required for collection during all seismic survey, will be analyzed in detail to be sure that mitigations are working effectively, and if not, how they can be improved.

BOEM's Atlantic programs will continue to expand long-term monitoring capabilities through the use of evolving technologies and platforms, and in close partnership with other agencies that have similar needs to monitor marine ecosystem and socioeconomic status and trends. Environmental studies will continue to utilize a variety of oceanographic platforms (e.g., moorings, ship-based studies, AUVs, animal tagging), in addition to aerial and satellite-based datasets to provide understanding of ecosystem health and productivity and potential impacts of OCS activities. Sustained deep water measurements of biological, physicochemical, and human use factors are currently rare in the Mid- and South Atlantic. An ecosystem-based approach is required in deep waters to provide an integrated perspective across multiple disciplines. In particular, the observing network will provide recordings of marine mammal vocalizations and the soundscape through use of passive acoustic monitoring, as well as crucial measurements of prey distributions and habitat conditions. This holistic approach to collecting ecosystem-based measurements is required for developing a more mechanistic understanding of observed changes both spatially and temporally in species distributions. Specifically, the integrated observing system will provide data to determine the various environmental factors that might be responsible for observed changes in distributions, thus, directly informing impact assessments related to oil and gas activities in the context of cumulative stressors (e.g., changes in meteorological and oceanographic conditions, storm events, climate change, other vessel activity, etc.).

New methods for aerial surveys will include the use of vertical photography. While this method has advantages over human observations, it yields high volumes of images that must be evaluated by individuals. Software to scan the images exists, but still needs to be refined. Developing the software will enhance the ability to use this new technology.

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APPENDIX I: TABLES OF PROPOSED STUDIES for FY16 and FY17

Table 1. National Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
91	PS	1	Spatial Ecology of Pelagic Megavertebrates
96	HE	2	High Resolution Aerial Imaging for Surveying of Ocean Use by Humans and Marine Animals
98	SE	3	Annual IMPLAN data purchase to support BOEM's Socioeconomic Models
99	IM	4	Support for the Fourth International Conference on the Effects of Noise on Aquatic Life
101	HE	5	Sponsorship Funding of the Sixth Symposium on Deep-Sea Corals, 2016
103	HE	6	Launching the National Animal Telemetry Network
106	IM	7	Demonstrating BOEM's Environmental Mission, Highlighting Avian Biology Data and Information Collected to Support Marine Spatial Planning and Renewable Energy Development
110	PS	8	Habitat Use of Polar Bears in the Chukchi Sea Planning Area
112	PS	9	Developing the Next Generation of Animal Telemetry: A Partnership to Develop Cost Effective, Open-Source, Marine Megafaunal Tracking
115	HE	10	Phase II Development of the Tethys PAM Metadata System
117	PO	11	How Varying Ocean Temperature and Sea State Affect Received Sound Pressure and Sound Exposure Levels in the Central and Eastern Gulf of Mexico
Discipline Codes			
HE = Habitat & Ecology IM = Information Management PS = Marine Mammals & Protected Species PO = Physical Oceanography SE= Social & Economic Sciences			

Table 2. Renewable Energy Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
119	PS	1	A Parametric Analysis and Sensitivity Study of the Acoustic Propagation for Renewable Energy Sources and Projects
122	HE	2	Commercial Shipping and Fishing Vessel Activity Effects on Seabird Distribution and Abundance on the Atlantic OCS
124	PS	3	Detection of Marine Species from High Resolution Aerial Vertical Photography Using Automated Anomaly Detection Software
126	PO	4	Impact Assessment and Mitigation of Offshore Wind Turbines on High Frequency Coastal Oceanographic Radar
129	IM	5	Literature Review of Wind Energy Facility Impacts to Local Meteorology
130	SE	6	Quantifying the Changes in Air Pollution from Offshore Wind Development for the Mid-Atlantic Region
132	FE	7	Sediment Mobility on the Mid-Atlantic Continental Shelf
135	HE	8	Spatial Ecology, Movement Patterns, and At-Sea Habitat Use of Nearshore Seabirds: Addressing Needs for Renewable Energy Development
137	SE	9	Standards for the Collection and Analytical Processing of Subsurface Core Samples
139	PS	10	Testing an Offshore Buoy-Based Nanotag Receiving Station
141	PS	11	Tracking Movements of Threatened Red Knots in the NW Atlantic
143	PS	12	Understanding Whale Occurrence, Habitat Use, Density, and Abundance in the Wilmington and Kitty Hawk Wind Energy Planning Areas using Passive Acoustic Monitoring
145	HE	13	Use of Acoustic and Thermographic Observations to Understand Seasonal and Weather-related Patterns of Marine Birds and Bats
Discipline Codes			
FE = Fates & Effects IM = Information Management PO = Physical Oceanography			HE = Habitat & Ecology PS = Marine Mammals & Protected Species SE= Social & Economic Sciences

Table 3. Marine Minerals Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Program Ranking	Study Title
148	PS	1	Discerning Behavioral Patterns of Sea Turtles in the Gulf of Mexico to Inform Management Decisions
150	HE	2	Glider-Based Fish Tracking Along Sand Shoals off Cape Canaveral, Florida
152	HE	3	Regional Essential Fish Habitat Geospatial Assessment and Framework
155	HE	4	Evaluating Use of Borrow Area Designs to Improve Post Dredging Habitat Value in OCS Sand Mining Projects
Discipline Codes			
HE = Habitat & Ecology PS = Marine Mammals & Protected Species			

Table 4. Alaska Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
157	PS	1	Aerial Surveys of Arctic Marine Mammals (ASAMM) – Personnel and Aircraft Needs
159	IM	2	Collaboration with the North Pacific Research Board (NPRB) Arctic Marine Research Program
161	AQ	3	Community Web Access to WRF Atmospheric Model Results and Meteorological Station Data, 1979-2009
162	FE	4	Updates to the Fault-Tree for Oil Spill Occurrence Estimators
164	SE	5	Community Based Monitoring: LEO Network
166	PS	6	Estimation of Abundance and Demographic Rates of Pacific Walruses Using a Genetics-Based Mark-Recapture Approach
168	PO	7	Development of an Arctic Trajectory Analysis Planner (TAP)
169	SE	8	Synthesis of Sub-Seabed Physical Environmental Data for the Beaufort and Chukchi Seas

171	HE	9	Updating Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet
173	PS	10	Marine Mammal Distribution, Abundance, and Ecology in Cook Inlet
175	HE	11	Arctic Ecosystem Integrated Survey, Phase II
Discipline Codes			
AQ = Air Quality			FE = Fates & Effects HE = Habitat & Ecology
IM = Information Management			PS = Marine Mammals & Protected Species
PO = Physical Oceanography			SE= Social & Economic Sciences

Table 5. Alaska Studies Proposed for the FY17 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
178	HE	N/A	Algae, Zooplankton, Fish Profilers (AZFP) on Arctic Moorings and Gliders
180	HE	N/A	Foodweb Simulation Models to Connect Humans and Marine Mammals with Lower Trophic Organisms
183	PS	N/A	Data Portal of Historical Acoustic Recordings to Quantify Bowhead Acoustic Occurrence and Assess Variability in the Acoustic Environment of the Chukchi and Beaufort Seas
185	PS	N/A	Monitoring the Distribution, Abundance, and Habitat Use of Walruses in the Eastern Chukchi Sea (Extension)
187	PO	N/A	Enhanced Verification and Interpretation of Freeze-Up Conditions for the Northeast Chukchi Shelf
189	SE	N/A	Archaeological Resource Baseline Study for the Beaufort and Chukchi Seas
Discipline Codes			
HE = Habitat & Ecology			PS = Marine Mammals & Protected Species
PO = Physical Oceanography			SE= Social & Economic Sciences

Table 6. Gulf of Mexico Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
191	HE	1	Long-Term Coral Reef Monitoring at the Flower Garden Banks, Gulf of Mexico: 2016-2018
194	AQ	2	Year 2017 Gulfwide Emissions Inventory Study
196	SE	3	Surveying and Testing Submerged Paleolandform Features in the Western Gulf of Mexico: The McFaddin Beach Project
199	SE	4	Socioeconomic Impacts of OCS Infrastructure: Shifts in Recreational Behaviors
202	PS	5	Seismic Survey Mitigation Measures and Marine Mammal Observer Reports
204	IM	6	USA-Mexico Workshop to Coordinate Future Environmental Studies Related to Ocean Energy Management in the Gulf of Mexico
206	FE	7	A Hydrocarbon Inventory of the Gulf of Mexico
208	HE	8	Potential Effects of Oil and Gas Exploration and Development on Benthic Communities at Selected Deepwater Sites (>2,000m) in the Gulf of Mexico
210	SE	9	Mapping the Late-Pleistocene Landscapes of the Gulf of Mexico through 3D Seismic Analysis
213	SE	10	Interdisciplinary Research at the Site of Three 19th Century Deepwater Shipwrecks: the Monterrey Shipwrecks
Discipline Codes			
AQ = Air Quality FE = Fates & Effects HE = Habitat & Ecology IM = Information Management PS = Marine Mammals & Protected Species SE= Social & Economic Sciences			

Table 7. Gulf of Mexico Studies Proposed for the FY17 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
215	PO	N/A	A Profiling-Buoy Based Observing System for the Deep Gulf of Mexico
216	SE	N/A	Archaeological Investigation of the *C.P. Baker* Shipwreck Site
218	SE	N/A	Assessing Temporal and Spatial Variability in Community and Parish-Level Responses to Oil Spills and Other Events in Coastal Louisiana
221	SE	N/A	Assessment of the OCS Leasing Program's Demographic Effects on the Gulf of Mexico Region
223	HE	N/A	Cumulative Impacts of Human Activity on Coastal and Marine Ecosystems of the Gulf of Mexico
225	IM	N/A	Evaluation of Commercial Unmanned Aircraft System (UAS) Use in Support of Mitigation Requirements Within the Gulf of Mexico
227	SE	N/A	Gulf of Mexico Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology & Archaeology II (GOM-SCHEMA II) Project
229	HE	N/A	Hydrocarbon-Degrading Symbionts in Deepwater Corals
231	HE	N/A	Nocturnal Surveys for Migratory Birds and Insects in Association with Lighting at Offshore Oil Production Platforms, Gulf of Mexico
234	HE	N/A	Seabird Surveys and Modelling in the Offshore Gulf of Mexico
235	SE	N/A	Social and Economic Impacts of Outer Continental Shelf Activity on Individuals and Families (Update One)
237	PO	N/A	Testing Chang and Oey's (2011) Gulf of Mexico Oscillator Hypothesis: A Field Program
239	SE	N/A	The Production and Distribution of Subsistence in Coastal Gulf of Mexico
241	PO	N/A	Tracer Experiments for Atmospheric Dispersion Model
Discipline Codes			
HE = Habitat & Ecology IM = Information Management PO = Physical Oceanography SE= Social & Economic Sciences			

Table 8. Pacific Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
243	IM	1	Scenarios for Replacing Conventional Energy with Offshore Renewable Energy Along the Central California Coast
245	SE	2	Recreation, Tourism, and Community Perspectives in Southern Oregon Before and After Offshore Wind Development
247	FE	3	Assessing the Impact of Oil Spills to Subsurface Biota using Three-Dimensional Oil Spill Modeling
249	HE	4	Disturbance Index Development for the Pacific OCS
251	HE	5	Predicting Species Distribution and Habitat Alteration Based on Sea-level Rise
253	PS	6	California Current Cetacean and Ecosystem Assessment Survey and Use of Data to Produce and Validate Cetacean and Seabird Density Maps
255	HE	7	Analysis of Long-term Seabird Colony Legacy Data in the Pacific Northwest as a Regional Baseline
257	HE	8	Baseline Characterization of Unsurveyed Southern California Rocky Intertidal Communities
Discipline Codes			
FE = Fates & Effects HE = Habitat & Ecology			
IM = Information Management PS = Marine Mammals & Protected Species			
SE= Social & Economic Sciences			

Table 9. Pacific Studies Proposed for the FY17 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
259	HE	N/A	Predicting and Detecting the Effects of Climate Change and Ocean Acidification Using Long-term Ecological Data
261	HE	N/A	Pacific Regional Investigation Survey and Monitoring (PRISM)
Discipline Codes			
HE = Habitat & Ecology			

Table 10. Atlantic Oil and Gas-Related Studies Proposed for the FY16 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
263	IM	1	Atlantic OCS Science Forum for Oil and Gas Decision Making - Information Sharing and Assessing Research Needs for Human and Environmental Resources
265	HE	2	Atlantic Deepwater Ecosystem Observatory Network (ADEON) – An Integrated System for Long-Term Monitoring of Ecological and Human Factors on the OCS
267	FE	3	Alternative Oil Spill Occurrence Estimators for the Atlantic OCS – Fault Tree Method
269	HE	4	Data Synthesis and Advanced Predictive Modeling of Deep Coral and Hardbottom Habitats in the Southeast Atlantic: Guiding Efficient Discovery and Protection of Sensitive Benthic Areas
272	AQ	5	Air Quality Impact Assessment for the Atlantic Oil and Gas Development
274	HE	6	Development of an Atlantis Model for the Mid and South Atlantic OCS to Facilitate Strategic Planning and Cumulative Impact Evaluation
Discipline Codes			
AQ = Air Quality FE = Fates & Effects HE = Habitat & Ecology IM = Information Management			

Table 11. Atlantic Oil and Gas-Related Studies Proposed for the FY17 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
276	HE	N/A	Deepwater Atlantic Habitats II: Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities
278	PO	N/A	Mid and South Atlantic Ocean Modeling
279	SE	N/A	Environmental Justice Baseline for the Mid and South Atlantic
281	FE	N/A	Baseline Geochemical Characterization of the Mid and South Atlantic Outer Continental Shelf
Discipline Codes			
HE = Habitat & Ecology FE = Fates and Effects PO = Physical Oceanography SE = Social & Economic Sciences			

APPENDIX II:

FY16-FY17 STUDY PROFILES ORGANIZED BY REGION

Environmental Studies Program: Studies Development Plan FY 2016–2017

Study Area(s):   All

Administered By: Headquarters

Title: Spatial Ecology of Pelagic Megavertebrates

BOEM Information Need(s) to be Addressed: Regulatory drivers such as the Marine Mammal Protection Act, Endangered Species Act, and Magnuson-Stevens Fishery Conservation and Management Act require BOEM to consider the impacts of regulated activities on protected and managed species. Assessing the potential impacts from geological and geophysical (G&G) surveys on site fidelity, movement, habitat use, and behavior of marine species is required to support BOEM's environmental compliance and impact analysis. Of particular importance is understanding what, if any, impacts G&G surveys may have on (1) the health and sustainability of pelagic highly migratory fish species (HMS), and (2) deep-diving, acoustically sensitive cetaceans (e.g., beaked whales). These species inhabit areas proposed for deep seismic G&G and may be affected by these activities. BOEM is required to design and implement mitigation measures to reduce or eliminate impacts from regulated activities on protected and managed species. In the Atlantic OCS, this is challenging due to a lack of data on these infrequently observed, cryptic species.

Approx. Cost: (in thousands) $4,500   **Period of Performance:** FY 2016-2019

Description:
Background: Numerous studies suggest that HMS (swordfish, billfish, tunas and sharks) and cetaceans, particularly deep-divers such as beaked and sperm whales, may be disturbed or injured by intense sound sources. Beaked whale strandings have been observed in areas where high source level activities were taking place, and reduced catch rates for fisheries have been reported near seismic surveys. Seismic surveys have also resulted in increased catches for some HMS and gear types but decreased catches for others; they may also result in species distribution shifts.

The issue of sound and how it may affect fish and fisheries is a topic that BOEM has put effort into exploring. The BOEM Workshop on the Effects of Noise on Fish, Fisheries, and Invertebrates explored the data gaps and research needs on this topic, especially regarding the use of passive acoustics to identify spawning aggregations as a potential mitigation strategy. Data gaps in our understanding of the sensitivity of fishes to noise are also well documented in the research community. Many HMS fisheries are valuable sources of income to residents and states adjacent to the areas of ongoing renewable and marine minerals projects as well as areas where oil and gas activities have been proposed. The impacts to the species and thus the fisheries are of intense interest to stakeholders. There are also several species of deep diving cetaceans that occur in the same areas of the mid- and south Atlantic whose behavior and habitat usage are poorly

understood. Information obtained by this project will ensure BOEM addresses concerns expressed in numerous stakeholder comments, such as, complying fully with environmental regulations and considering impacts of its programs on existing users of the OCS, such as commercial fisheries.

Traditional survey methods for cetaceans include shipboard or aerial surveys. However, these are not sufficient for deep diving cetaceans due to their cryptic nature and offshore distribution. Similar challenges exist for HMS; they are not easily detected through aerial and ship based visual and passive acoustic surveys. These factors result in significant data gaps in the distribution/occurrence of these species in the Atlantic region, which impairs BOEM's abilities to assess the potential impacts of acoustic disturbance from G&G activities. This study will build upon existing efforts such as Atlantic Marine Assessment Program for Protected Species (AMAPPS), and will work in partnership with U.S. Navy and NOAA supported projects by addressing data gaps in areas offshore where the distribution of these understudied fauna may intersect with seismic survey activities. Currently, AMAPPS visual and acoustic survey effort drops off considerably approximately 50 miles from shore. The current extent of proposed G&G survey activities and potential oil and gas leasing activities extends well beyond 50 miles, making it essential that BOEM gain a better understanding of how species use this area in order to evaluate impacts. This study will provide necessary information for planning and compliance with environmental regulations.

Objectives: The objectives of this study are to: a) Gather existing environmental and telemetry data into a synthesis of available mid- and south Atlantic animal movement data; b) Describe site fidelity and habitat use to increase confidence in habitat models for pelagic HMS fishes and deep-diving cetaceans outside the range of existing survey efforts where significant data gaps exist; c) Describe acoustic, behavioral, and foraging ecologies of pelagic deep diving cetaceans and apex predatory fishes in conjunction with oceanographic conditions; d) Create species distribution/movement models and uncertainty analysis for Atlantic OCS cryptic species to inform planning and mitigation design for G&G activities; e) Verify and/or establish cue rates (acoustic and visual) to inform accurate density modeling of data deficient marine mammal species applicable to multiple BOEM programs for impact analysis across programs.

Methods: Due to the costs associated with traditional vessel survey time in the Atlantic planning area, this study will, in conjunction with both NOAA and Navy projects, use an integrated, multi-platform approach for obtaining data that will be crucial for BOEM decision-making processes. This project will utilize three primary, proven methods: 1. Vessel and AUV-based mobile passive acoustic monitoring (PAM); 2. Long-term bottom-mounted PAM receivers; 3. Animal tagging. To maximize cost effectiveness, this project will initially use mobile (i.e., vessel and AUV-based) PAM, which, in addition to providing key data of its own, will also provide the information needed to choose locations for four additional PAM buoys in the Atlantic OCS, thus supplementing existing Navy/NOAA fixed archival PAM units supported by the AMAPPS project. Together these techniques will accomplish at least three goals: i) tag and detect fish via acoustic tags; ii) record, classify and localize cetacean calls; iii) acoustically detect spawning aggregations for commercially important fish (e.g., grouper/snapper).

Utilizing a state of the art sailing vessel designed specifically for surveys (visual and acoustic) will allow many days at sea (60/year), which will provide robust temporal and spatial coverage. Also, importantly, the vessel and AUV-based PAM will provide ground truth and guidance for the PAM buoys (e.g., vocalization rates and locations of spawning aggregations), which are critical for long-term use of PAM techniques for mitigation and monitoring of industrial activity. Electronic tags such as satellite linked position tags and 3D accelerometer/acoustic tags will also be used to augment remote study of targeted species to provide a better understanding of habitat use and movement in relation to potential activities. Such tagging strategies have provided superb data for both mammals and fishes, and the techniques and technologies are readily available so can be easily and cost effectively deployed.

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Environmental Studies Program: Studies Development Plan FY 2016–2017

Study Areas: All

Administered By: Headquarters

Title: High Resolution Aerial Imaging for Surveying of Ocean Use
                             by Humans and Marine Animals

BOEM Information Need(s) to be Addressed: This study will provide large scale, synoptic data that will provide foundational information for environmental analysis by BOEM. By implementing new technology, already tested by BOEM, information needs will be met for understanding the distribution and abundance of marine animals as well as human use in the marine environment. Products resulting from this study will be used for NEPA analysis, region specific environmental assessments, review of applications for permits, and development of the Five Year Plan for Oil and Gas Development.

Approx. Cost: (in thousands) $4000   **Period of Performance:** FY 2016-2020

Description:
Background: High resolution aerial imaging has been demonstrated to be a valuable tool in Europe for environmental monitoring of both marine animals as well as human uses. BOEM funded a pilot study in 2009 to determine the feasibility of deploying this technology on the U.S. Outer Continental Shelf (Normandeau 2013). This study found that high resolution aerial imagery was a safe cost effective method that can provide scientifically robust information on the distribution of birds, mammals, and sea turtles in the marine environment. Although not the focus of this previous study, it is apparent from the imagery collected that this technology can also captures human uses of the marine environment.

High-resolution aerial surveys can cost less than conventional aerial and vessel based surveys, however there real value is safety and accuracy.   This new technology allows for a flying at higher altitudes, and thus facilitates safer flights. Just as important, this technology allows for more accurate density calculations due to: 1) higher flights that tend not to disturb marine fauna 2) the creation of a high quality, durable record allowing for repeated examination over a long period of time (e.g., decades) and 3) the ability to precisely calculate survey boundaries.

The purpose of this project is to operationalize this technology at a large scale, perhaps three BOEM planning areas, to test the feasibility of implementing repeated long term surveys across the outer continental shelf. There is interest among other government agencies to begin utilizing this technology and the recent BOEM study has documented the methods needed to equip USFWS and NOAA aircraft with the necessary equipment. Cost sharing options will be pursued with other government agencies with need for similar data.

Objectives: The objective of this study is to gather large-scale geographic information on the distribution and abundance of marine organisms including, birds, sea turtles and marine mammals as well as the spatial patterns of human uses of the ocean.

Methods: High-resolution aerial imaging will be used to sample three BOEM planning areas multiple times during a single year.   The technology deployed will be based on a previous pilot study. Digital geographic data products will be developed include patterns and distribution of human uses such as fishing, boating, kayaking, surfing and potentially other recreational uses, as well as the density and distribution of marine animals.

It is estimated that these surveys will be conducted at a regional scale with a study area of approximately 25,000 km2, a 10% sampling area, and quarterly sampling. Observations will be identified, categorized and converted into a geographic data layer. Software may be used to identify "targets," however it is anticipated that identification, such as species, will be made by manual visual interpretation. Planning areas will be chosen based on information needs and the ability to complement existing research. There is significant interest in completing surveys in the Gulf of Mexico, so this may be the first area selected.

Revised Date: May 13, 2015

Reference:

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Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   All

Administered By: Headquarters

Title: Annual IMPLAN data purchase to support BOEM's
                                           Socioeconomic Models

BOEM Information Need(s) to be Addressed: The Bureau of Ocean Energy
Management (BOEM) needs to purchase the latest IMPLAN data for use in MAG-PLAN
Gulf of Mexico and MAG-PLAN Alaska (internal regional economic impact models), as
well as for miscellaneous regional analyses.

Approx. Cost: (in thousands) $217   **Period of Performance:** FY 2016-2018

Description:
Background: BOEM is the administrative agency responsible for leasing submerged
Federal lands. The Outer Continental Shelf (OCS) Lands Act, as amended, requires the
preparation and maintenance of a current 5-year schedule of proposed lease auctions
("5-year program"), and the National Environmental Policy Act (NEPA) of 1969 requires
preparation of an environmental impact statement (EIS) prior to any major Federal
action, including a 5-year program or a lease auction ("lease sale"). When BOEM
prepares a new 5-year OCS oil and gas leasing program or an EIS, region-specific OCS
Economic Impact Models called MAG-PLAN Gulf of Mexico and MAG-PLAN Alaska are
used to estimate the additional employment, personal income, etc., anticipated to result
from each alternative formally put before the Secretary of the Interior for a decision.
These models are built to utilize economic multiplier data derived from the data sets
developed to be run with a commercial, off-the-shelf economic modeling software
package called IMPLAN.

Objectives: The objective of the IMPLAN data purchase is to obtain the latest
employment, labor income, and other economic multipliers for the two versions of
MAG-PLAN, as well as to have the IMPLAN data available for miscellaneous other
economic analysis assignments. These assignments include preparing data for the
Secretary's annual economic report, which requires data for each state in the country.
Current BOEM IMPLAN data are for 2013, but the updated data are available each year.

Methods: The purpose of this effort is to provide all BOEM users with necessary data
and user licenses for the annually updated IMPLAN data. BOEM intends to purchase
one five-user license (five users, one at any given time) for the National Package (all
states) each year for the next 3 years.

Revised Date: April 20, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   All

Administered By: Headquarters

Title: Support for the Fourth International Conference on the
                           Effects of Noise on Aquatic Life

BOEM Information Need(s) to be Addressed: Ocean sound and noise continues to be a significant environmental concern for BOEM and many of its stakeholders. It is a central issue across all program areas and regions. There is a constant need for BOEM to not only support further research on this topic but also gain access to the latest scientific and management information. This conference occurs every three years and is the only conference of its kind in the world. It provides excellent information on scientific information and regulatory strategies in different jurisdictions and access to domestic/international colleagues and stakeholders highly engaged on this issue. Results may identify specific research needs for BOEM or suggest potential mitigations and management strategies. In addition, support and participation of this conference also allows BOEM to disseminate its own research and management information as well as reinforce its role as a key player on this issue

Approx. Cost: (in thousands) $25   **Period of Performance:** FY 2016

Description:
Background: For several decades, BOEM has been engaged on marine sound issues. It is present on BOEM's research program and environmental assessment work and is also a key topic in litigation against BOEM. While emphasis has been on effects on marine mammals, recent concerns have arisen about effects of the same sounds on fish, fisheries, sea turtles and invertebrates. The issues revolving around effects of sounds on aquatic life are extensive and complex. They range from differences in the sources of sounds potentially affecting aquatic life, the diversity of species affects, the potential different effects on animals with different anatomy and physiology, and effects on animals living in different habitats. The complexity arises, in part, from current difficulties in extrapolating between sounds with different characteristics and between species with different body structures.

The Fourth International Conference on the Effects of Noise on Aquatic Life, like its previous conferences, aims to bring experts together from both the scientific and regulatory disciplines to information share and increase collaboration on ocean noise issues. Past conferences have been highly successful in facilitating interaction between the scientists investigating these questions and the regulators and industrial users of sound who need the answers. They also helped define major research questions, significantly increased BOEM partnerships and were instrumental in disseminating BOEM's science and interests on this issue. Feedback from participants and supporters of the previous conferences demonstrated a strong need to continue in subsequent conferences the generated dialog and collaborations.

<u>Objective:</u> The objective of this study is to co-fund a conference that will provide a venue for the collection and sharing of research and management strategies related to the effects of noise on aquatic life. The event will provide an opportunity for networking among all attendees and possible research collaborations. It will also serve as an opportunity for BOEM to disseminate results from its research and assessment of ocean noise issues.

<u>Methods:</u> With BOEM co-funding, a conference will be conducted using a standard general conference format with multiple sessions for presentations and a poster session. Also, as with the previous conferences, an advisory board likely will be convened to guide the development of program topics and selection of presenters. BOEM has served on the advisory boards for the previous three conferences.

Revised Date: January 15, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   All

Administered By: Headquarters

Title: Sponsorship funding of the 6th Symposium on Deep-Sea Corals 2016.

BOEM Information Need(s) to be Addressed: The Bureau of Ocean Energy Management (BOEM) is a world leader in funding research on deep-sea corals both in the Gulf of Mexico and Atlantic. The International Symposium on Deep-Sea Corals is the most significant gathering of global deep-sea coral scientists, bringing together scientists from many countries including leading experts to present the results from current research. Papers being presented include many originating from award-winning studies funded by BOEM. Co-sponsorship will also indicate the continuing dedication of the agency to environmental stewardship of these sensitive deep-sea habitats.

Approx. Cost: (in thousands) $20   **Period of Performance:** FY 2016

Description:
Background: The International Symposium on Deep-Sea Corals is convening its 6th (ISDSC6) event in Boston Massachusetts in September 2016. This international symposium is held only every three to four years and highlights the recent achievements in the field of unique ecosystems where BOEM has funded numerous studies. Previous meetings have been in Netherlands, New Zealand, Miami Florida, and Germany and Canada. These Symposia are attended by leading scientists, resource managers, educators and students and will include presentations of work derived from studies funded by BOEM. The two principal Symposium organizers are both past principal investigators of previous BOEM deep-sea coral studies. The conference provides a unique opportunity for both a learning opportunity to obtain the results of the most recent research in this habitat area of concern, but also demonstrate the dedication of BOEM to maintaining its prominent position in the science and research of deep-sea corals. Continued support and participation will reinforce recognition of the agency's dedication to the use of sound science through applied studies and future discussions regarding management policy for these sensitive habitats that are especially abundant in the Gulf of Mexico but also now well documented by an ongoing study of mid-Atlantic Canyons.

The symposium will publish abstracts with indication of BOEM co-sponsorship in both hard copy publication and continuous availability through a permanent website.   Past support and recognition can be viewed at previous web sites; 2005; http://conference.ifas.ufl.edu/coral/ 2008; http://coral2008.niwa.co.nz/, and for 2012; http://www.deepseacoral.nl/,

Objective: The objective of this study is providing financial support for the convening of the conference and thereby facilitating formal presentations, workshops, and informal

discussions on the most current research on deep-sea corals, including regions and coral species of concern to BOEM.

In addition, BOEM will receive the following in consideration for its financial contribution:

1. Logo rights: Website, Conference Handbook (full page), Speaker podium
2. Attendance rights: Registration (2 persons), Conference diner, Icebreaker, Chair a session, Introduce speakers
3. Booth at central location during conference
4. Banner display at: Conference entrance, Conference diner, Conference rooms

Methods: BOEM will co-fund this conference along with other contributors, and the ISDSC6 will plan, organize, and conduct the conference. The ISDSC6 will oversee the production of the conference abstracts provided to sponsors and participants.

Revised Date: March 16, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   All

Administered By: Headquarters

Title: Launching the National Animal Telemetry Network

BOEM Information Need(s) to be Addressed: The systematic and expanded use of animal tags via a national animal telemetry network will enable BOEM to improve its impact assessment through an ecosystems approach in addition to the more common but still important assessments of impacts to individual species/populations. With the advent of multi-sensor tags, ancillary environmental information can be obtained, such as temperature, salinity, pH, etc. as well as recorded animal vocalizations. These kinds of observations, made concurrently with animal locations and diving behavior, add important context for better understanding of the roles that potentially impacted animals play in marine ecosystems. This should improve BOEM's impact assessments and, perhaps, in formulating mitigation strategies.

Approx. Cost: (in thousands) $1,750   **Period of Performance:** FY 2016-2020

Description:
Background: Some of the earliest applications of animal tags (instrumentation physically attached to animals to (principally) observe their movements over time and (secondarily) any other associated variables of biological interest) have radically altered our understanding of how animals utilize their environment and interact with other members within a shared ecosystem. A prominent example has been the tagging of elephant seals in the Pacific northeast (Robinson, et al., 2012), wherein these animals previously understood as coastal were seen foraging at great distances from their coastal haul-out areas. And, quite remarkably, tagged elephant seals in the Antarctic helped discover a previously unknown source of Antarctic Bottom Water (Ohshima et al., 2013). BOEM-funded research has also made use of animal tags that have filled-in missing ecological information such as the seasonal migratory range of the bowhead whales during winter, spring, and summer. (The fall migration of bowheads had been exhaustively studied by more than three decades of aerial surveying.) There have been many other studies of terrestrial and aquatic animals using remotely tracked tags which resulted in much more comprehensive understanding of the animals and their relationship to the ecosystems they inhabit, and often in situations where comparable information via other means would have been prohibitively expensive or technically impractical.

In 2011 and 2012, several U. S. scientists with prior experience with tagging marine animals met to discuss the concept of a national animal telemetry network (ATN) of current and potential collectors and users of animal tag data for the purpose of initiating more comprehensive and coordinated monitoring of the U. S. marine environment over many spatial and temporal scales. Tag data archiving and data standardization was to

be a part of the network, and the effort was to be conducted through the U. S. Integrated Ocean Observing System (U. S. IOOS) to be better integrate the ATN with other long-term observing of the marine environment.

The result of these meetings and many subsequent teleconferences and e-mail exchanges is a strategic plan to initiate and co-fund a national ATN (http://www.ioos.noaa.gov/observing/animal_telemetry/national_atn_sp_draft_final1.pdf) for the purpose of facilitating conservation and sustainable management of commercially harvested species, protected species, and other living marine resources. The ATN is intended to be a multidisciplinary approach, integrating physical, chemical, geological, and biological variables of ecological relevance and to establish common data and metadata structures so observations from many projects can be easily combined for subsequent analyses by future investigators requiring greater temporal or spatial coverage.

The cost of this effort will be shared with other federal agencies. In particular, NOAA, through the IOOS Program Office, and the Navy, through the Office of Naval Research's Marine Mammals Program Office, have been the principal drivers of this effort and are expected to make a major financial contribution to the ATN.

Objective: The objective of this study is to initiate (launch) the national ATN in collaboration with other interested, co-funding federal agencies for the purpose of:

1. providing a scientific basis for marine fisheries and protected-endangered species management;

2. determining and delineating critical habitats;

3. providing real-time (or near real-time) monitoring of marine fish, turtles, birds, and mammals;

4. evaluating the potential effects of anthropogenic disturbances; and

5. improving coupled ocean-atmosphere observation and forecasting models.

Methods: Through the good offices of the U. S. IOOS, the nascent ATN will do the following.

1.   Invest in, deploy and maintain a combination of key assets (archival, satellite and acoustic tags and infrastructure) through the U.S. IOOS Regional Associations forming the backbone of a national ATN.

2.   Develop and maintain a national data management capacity by establishing common data standards and an infrastructure for animal telemetry data flowing through the Regional Associations and interoperable with international systems.

3.   Develop a plan for sustained long-term support for a) maintenance of infrastructure for receiving data (such as acoustic receiver arrays), b) tag deployment through the U.S. IOOS Regional Associations (e.g. animals carrying sensors on all coasts), c) data management system and capacity challenges, and d) advancement of technology to ensure ongoing biological and geophysical animal telemetry observations.

4.   Synthesize animal telemetry products and increase their availability to support aquatic species management, to promote training in relevant emerging disciplines (e.g. GIS, sensor technologies),and advance the presidential National Ocean Policy Implementation Plan.

5.   Advance the national capacity for accessing animal oceanographic telemetry data in near-real time via the Global Telecommunications System (GTS), and enhance the capacity to assimilate ATN data daily into ocean models.

6.   Establish pathways for rapid data sharing and maintenance at regional, national and international levels. This will help avoid duplication of effort and ensure data are compatible and accessible for analyses and assimilation by computer models.

7.   Promote investment in new and lower cost tags and sensors (e.g. pH and oxygen sensors) in response to growing concerns about the potential impacts of ocean acidification and hypoxia on marine biological resources and the health of marine ecosystems.

8.   Expand animal telemetry outreach and education programs. Animals are a way to foster public understanding of the value of the ocean, coasts, great lakes and ocean observing systems.

Revised Date: May 14, 2015

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Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s): All

Administered By: Headquarters

Title: Demonstrating BOEM's environmental mission in support of marine spatial planning by standardizing avian biology studies geospatial data and metadata deliverables

BOEM Information Need(s) to be Addressed: BOEM needs to improve the discoverability, presentation, and access to information to be used in its energy development decisions under a variety of mandates, including: 1) the 2013 National Ocean Policy (NOP) Implementation Plan to contribute to a national ocean data portal (ocean.data.gov), 2) the National Environmental Policy Act, 3) a variety of Office of Management and Budget directives and Executive Orders. Specifically, avian biology information needs to be federated at the national level to provide a coherent presentation of variety of BOEM's avian biology research activities.

Approx. Cost: (in thousands) $250   **Period of Performance:** FY 2016-2017

Description:
Background: BOEM is committed to supporting the National Ocean Policy (NOP) initiative and has contributed greatly towards developing a national ocean data portal (ocean.data.gov). The ocean.data.gov portal is a shared federal resource that reaches all of BOEM's stakeholders and the general public, and is an important component of BOEM's support for the NOP implementation strategy to improve scientific understanding and information (see: http://www.boem.gov/Data-Tools-and-Portals/). The NOP implementation plan (2013) also calls for a Data and Information Working Group (DIWG) to spearhead its further development in coordination with federal ocean agencies.

Efforts underway by the DIWG involve standardizing elements of the geospatial data and metadata so that they can be more coherently presented across the federal space. Geospatial metadata is presented in the ocean.data.gov portal, and it has the capability to carry a great deal of geoscientific information. Further, the geospatial data discovered through the ocean.data.gov portal may be made accessible through the National GeoPlatform through a shared OMB funded data.gov infrastructure. BOEM should better leverage these nationally funded capabilities to help federate environmental studies data. BOEM is employing federation schemes already, using the Marine Cadastre and the recently enhanced Environmental Studies Program Information System (ESPIS). Enhanced BOEM data governance coordinated through the DIWG may help create a heightened level of recognition across federal agencies and in the public sector for examples of environmental research efforts that support the BOEM mission.

BOEM established a Data Management, Integration and Governance team (DM-IGT) to develop, implement, and govern standard operating procedures, protocols, and policies

for data management practices across BOEM. The DM-IGT has identified geospatial data and information collected as part of BOEM environmental studies as an initial focus area to implement its governance activities. However, BOEM environmental studies GIS data and metadata deliverables come in many forms and the DM-IGT needs to build a solid case for data governance at BOEM. In particular, a pilot study is needed to flesh-out how this would work, and requirements need to be put together for geospatial data deliverables from at least one subject area. Avian biology studies have been proposed as a relevant subject area for this effort, and the standards for geospatial data and metadata deliverables can be demonstrated for BOEM's avian biology data to serve as a springboard for the DM-IGT to target its efforts to other BOEM public geospatial data assets.

BOEM has contributed significantly to applied avian biology research on questions about protected species conservation and management. A variety of avian biology measurements are collected to support BOEM's environmental mission (see table), and make up BOEM's avian biology research program. BOEM's avian biology research program is forged through a variety of partnerships with U.S. federal research centers of the U.S. Fish and Wildlife Service, U.S. Geological Survey, and National Oceanic and Atmospheric Administration, and non-governmental and private sector entities.

All of these efforts contribute in some fashion to the production and management of geospatial data and metadata. A study is needed to help present these efforts to the public in a more coherent fashion, in order for BOEM to gain recognition for its critical role in this research community. Avian biology is a research discipline that is particularly relevant to current events in marine planning, such as recent developments in renewable energy interests on the Atlantic and Pacific OCS. Federating BOEM's Avian Biology data and information in the ocean.data.gov portal, under the leadership of the DIWG and through governance of the BOEM DM-IGT may serve as an important proof of concept for the role of data governance at BOEM, and may be a catalyst for the mobilization of other BOEM data in support of National Ocean Policy marine planning efforts.

Objectives:

This study will develop a simple instructions set for improving the presentation, discovery, and access of avian biology measurements and produce a more coherent view of BOEM's avian biology research. Avian biology measurements contribute to a variety decisions on OCS energy development, and the greater consistency in how these data are managed and published to the public is intended to improve the scientific use of the data and increase the openness and transparency with which BOEM makes regulatory decisions.

Capacity and knowledge will be developed to enable BOEM environmental studies data and metadata to more consistently:

- be linked to from BOEM website and BOEM databases such as the Marine Cadastre and ESPIS,

- be made discoverable through Departmental and Federal Public Data Listings,

- generate study results so that data from studies can be incorporated into relevant databases, such as the Atlantic Avian Compendium for avian biology data,

- enhance interagency coordination on avian biology research through a variety of allied efforts, such as the Avian Knowledge Network, and

- enhance the public's recognition of BOEM's contribution to scientific understanding and information.

Methods:

The BOEM DM-IGT will establish a focus group composed of BOEM data management professionals and external experts who are well versed in the capabilities and technology underlying national resources such as the ocean.data.gov portal. The focus group will work under the direction of the DM-IGT to develop guidelines and educational materials targeted to avian biologists to help in the consistent delivery of the variety of geospatial data and metadata that are collected in support of OCS energy development. As part of this study, they will:

- Create a set of simple instructions for BOEM SMEs, contractors, contracting officer representatives, and BOEM GIS analysts to understand their roles and responsibilities to ensure the standard delivery of avian biology geospatial data and metadata.

- Use the DIWG Marine Planning Taxonomy ([USGS Open File Report](#)) as the framework to federate avian biology geospatial data and metadata.

- Investigate improved capabilities leveraged from the latest internationally recognized metadata standard (ISO 19115-1) to better document each of the avian biology measurements commonly collected in BOEM environmental studies.

- Evaluate existing technology, resources, and partnerships, and develop plan for how all of BOEM's avian biology geospatial data and metadata can be coherently federated through the ocean.data.gov portal.

- Develop a suite of standards for BOEM avian biology geospatial data deliverables, including file format specification, database attributes, and data models, that can be referenced by BOEM environmental study partners in the delivery of new data and metadata to BOEM, and can leveraged by the BOEM DM-IGT when building out specifications for other public BOEM data and metadata.

- Author discipline focused educational materials, technical reports, and present demonstrations and pedagogical sessions at avian biology and ocean science focused conferences and workshops to illustrate data management approaches and societal benefits of scientific data management practices.

Table: Relevant Avian Biology Science Supporting BOEM's Mission

Category	Methods common to BOEM's Avian Biology Research	
Seabird tagging	VHF, Satellite, banding mark/ recapture	
Image/ visual based	Shipboard observer, Aerial observer, Aerial high definition	
Acoustic/ ultrasonic		
Non-specific methods	Thermographic, and radar	
Synthetic techniques	Avian Compendium, occurrence records, Predictive modeling	

Revised Date: June 6, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Chukchi Sea

Administered By: Headquarters

Title: Habitat use of polar bears in the Chukchi Sea Planning Area

BOEM Information Need to be Addressed: The polar bear was listed as threatened under the Endangered Species Act (ESA) in 2008 due to forecasted effects of habitat loss from climate warming. The Chukchi Sea Planning Area includes a significant portion of the range of the Chukchi Sea polar bear population, 1 of 19 worldwide. In order to comply with the ESA, National Environmental Policy Act (NEPA), and Marine Mammal Protection Act, BOEM needs information on the seasonal areas of overlap of oil and gas activities and polar bear habitat use to identify, analyze, avoid, minimize and mitigate potential environmental impacts. This study proposes to continue and expand sampling of polar bears in the Chukchi Sea to better understand movement patterns and habitat use in the Chukchi Sea planning area. A recent study documented polar bear habitats in the Chukchi Sea planning area using data collected between 2008 and 2013. This new five-year study will allow information to be collected on an expanded sample of polar bears to better understand annual variation in habitat use, more accurately assess polar bear use of the Chukchi Sea planning area, monitor the continued responses of polar bears to sea ice loss, and provide necessary information for an oil spill risk assessment.

Approx. Cost: (in thousands) 1,500   **Period of Performance:** FY 2016-2020

Description:
Background: Polar bears in the Chukchi Sea are experiencing significant and relatively recent declines in sea ice habitat and are currently exposed to both human-caused removal and expanding industrial development. Research conducted in 2008–2013 found that polar bear body condition and cub survival in the Chukchi Sea remained stable compared to an earlier period even after significant sea ice loss occurred. This might only be a transient pattern and continued loss of sea ice could eventually lead to negative population effects. This research also documented substantial use of the Chukchi Sea planning area by polar bears with significant interannual variation in use. Given the degree of sea ice loss expected in the coming years in the Chukchi Sea and the levels of interannual variation in the ecology and space use observed for polar bears, continued monitoring of the population is required to understand how bears are responding to these changes. This is especially important for identifying areas of the Chukchi Sea planning area that are most important to polar bears as these patterns could change quickly if sea ice conditions continue to deteriorate at a fast rate. Additional years of data will also help better inform movement and space use models to help evaluate the potential impacts to polar bears of an oil spill in the Chukchi Sea and to develop better contingency plans for such an event.

An additional factor that has limited inferential abilities from previous research is that polar bears were sampled from a single logistical base in Bering Strait. Broader geographical sampling is needed to target a subset of bears that are believed to center their home ranges on the boundary of the southern Beaufort and Chukchi Sea polar bear subpopulations which includes the Chukchi Sea planning area. Enhanced geographic sampling of polar bears could help further inform how polar bears in the Chukchi Sea are responding to sea ice loss, better understand the importance of the Chukchi Sea planning area to the population, and improve the precision of population estimates. Broader sampling could also help better delimit the area of shared use between the Chukchi Sea and Southern Beaufort subpopulations--an important factor for allocating harvest and for evaluating the impacts of any activities in this overlap area on the respective subpopulations.

This collaborative FWS-USGS study builds upon the results of the initial five year study by examining relationships between annual variation in sea ice conditions and bear habitat use, distribution, and ecology and determining potential mitigation for polar bears that may be needed in the course of industrial exploration and development. Sampling will be broadened to target bears on the eastern periphery of the Chukchi Sea. Expanded sampling on the eastern periphery will provided greater insight into the use of the Chukchi Sea planning area.

Objectives:
1.   Expand sampling effort to target bears most likely to use the Chukchi Sea planning area and update seasonal habitat use patterns of polar bears in this area.
2.   Evaluate the status of Chukchi Sea polar bears in response to continued sea ice loss.

Methods: Data collection will consist of the live-capture and release of 50–150 polar bears each spring. Helicopter-based captures will occur in the spring of the year on the sea ice, with logistical bases at the Red Dog Mine port facility and an additional location(s) to the north (e.g. Cape Lisburne, Wainwright) to improve representation of habitat use in the Chukchi Sea planning area. We will apply individual marks and satellite tags to captured polar bears, and obtain physical measurements and a suite of biological samples (e.g., hair, fat, and blood).

Resource selection functions will be used to determine seasonal polar bear habitat selection. The status of polar bears will continue to be monitored via reproductive indices (yearlings per female), body condition, and if possible, estimates of survival. With an additional 5 years of data to extend the data series (2008-2013), relationships between sea ice and polar bear habitat use, recruitment, and body condition can begin to be examined.

Cost sharing would be with U.S. Fish and Wildlife Service and U.S. Geological Survey. BOEM support would be used to expand existing collaborative study to include sampling of polar bears in the northeastern Chukchi Sea region.

Revised Date: February 4, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   All

Administered By: Headquarters

Title: Developing the Next Generation of Animal Telemetry: A Partnership to Develop Cost Effective, Open-Source, Marine Megafaunal Tracking

BOEM Information Needs To Be Addressed: This study implements BOEM's Outer Continental Shelf Lands Act mandate to monitor the marine environment adjacent to U.S. Outer Continental Shelf (OCS) operations. Understanding animal movement in the OCS is required for nearly everything under BOEM's purview. Telemetry is an important tool to support animal movement and behavior studies to supplement survey effort. Additionally, animal telemetry can be used to infer movements related to activities in the OCS, such as geophysical surveys, platform construction and demolition. Animal telemetry can provide relevant information for NEPA, MMPA, ESA consultations across program areas such as wind and hydrokinetic placement locations, oil/gas leasing and even used in monitoring impacts of climate change. Internal reports, such as BOEM's Effects of Offshore Energy Sound Producing Activities on Fish and Invertebrates as well as public comments on a variety of EIS, from the Arctic to Atlantic, call for a need for improved data on animal movement, behavioral, and foraging ecology.

Approx. Cost: (in thousands) $380   **Period of Performance:** FY 2016-2019

Description:

Background: Tracking of highly mobile marine megafauna is typically accomplished by Argos or Iridium/Inmarsat satellite. This study proposes development of an alternative method of OCS marine animal tracking by leveraging NASA's CubeSat partnerships with STEM universities and the Automatic Packet Reporting System (APRS). APRS is an amateur radio-based system for real time digital communications with transceivers located on land and low-earth orbit using NASA's CubeSat program.

Animal movement studies face several technological factors due to proprietary technology, limited radio transmission range, overhead satellite time limitations and most importantly, cost.   Cumulatively, these factors limit opportunity to gather information on animal movements throughout the US Exclusive Economic Zone. Producing an open-source transmitting tag which does not depend on the ARGOS satellite system significantly lowers costs by enabling use of a constellation of low cost, open source data relay CubeSats.

The CubeSat pico-satellites community can be leveraged to invest in a CubeSat alternative to the current ARGOS system. CubeSats are a class of small research-class spacecraft. NASA's CubeSat Launch initiative (CSLI) provides opportunities for small satellite payloads to hitch-hike on rockets planned for upcoming launches. This

program engages engineering schools across the United States to develop low-cost micro satellite experiments and has been developing and launching these CubeSats at a rate as high as 100 per year. Some CubeSats have adopted the APRS system for tracking position and relaying data of other transmitters. This is the same system that NASA maintains aboard the International Space Station for outreach to students and amateur experimenters around the world. Additional APRS transreceivers can be placed easily on the future CubeSats, as well as AUV's, ocean going vessels and existing buoys to create a truly wired ocean.

Marine Mammals, fishes and invertebrates of particular interest for impact analysis include those species that are commercially or recreationally important, are threatened or endangered, or are keystone (for example, important prey) species. Data collected by these tags can be relayed in real-time (or delayed mode) via satellite. Due to limited bandwidth in these transmissions not all of the data can be relayed. This results in a need for some data-processing on the tag and only a subset or summary of the data being recovered. However, as the instrument does not have to physically be recovered these tags can be deployed on animals not suitable for archival tags alone.

The planet is changing quickly, through this study BOEM can be a catalyst for a truly wired ocean. Though the implementation of this project, BOEM achieves improved tools for OCS monitoring, STEM partners are engaged in an innovative program, together leading to a tech savvy workforce while filling in gaps in OCS data cost effectively.

Objectives:
- Develop and demonstrate an OCS tracking/monitoring network for geographically and taxonomically diverse marine megafauna leveraging APRS/CubeSat open source tracking
- Demonstrate ability to track and transmit archival tag data using the CubeSat network
- Formalize the transition from the short term experimental licensing of these missions to a permanent UHF allocation for this open source project.
- Describe pelagic megafaunal movements outside the range of existing surveys

Methods: Using NASA's CubeSat launch initiative network we will utilize space-based transceivers aboard CubeSats and the International Space Station as well as ocean and terrestrial based transceivers to demonstrate the feasibility of tracking various marine megafauna. Accomplishing this will be done through the following.
- Develop and launch CubeSats for data link characterization
- Convene a workshop of the CubeSat community as well as ocean telemetry engineering experts to establish a standardized communication platform for low orbital pico-satellites
- Promote and encourage the CubeSat community to utilize APRS digipeater as a part of their communication system. This will drastically increase the number of space assets and coverage

- Convene a public competition to create a coding algorithm for managing big data associated with visualizing movements accurately
- Quantify data collection capability between Argos and CubeSat networks by characterizing the initial proof-of-concept CubeSat missions
- Ground-truth CubeSat animal tags in diverse scenarios

Revised Date: May 4, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   All

Administered By: Headquarters

Title: Phase II Development of the Tethys PAM Metadata System

BOEM Information Need(s) to be Addressed: The hardware and data processing / data analyzing used in passive acoustic monitoring (PAM) of the marine environment has matured greatly in recent decades. PAM is now serving as an important research tool and method of monitoring the marine environment for baseline determinations and assessing environmental impacts. As such, there is a need to standardize the documentation of and access to acquired PAM data for BOEM's various environmental protection responsibilities such as compliance with the MMPA and the ESA and to assess possible adverse impacts due to seismic surveying and pile driving. This study will help in these matters by greatly enhance the accessibility and usefulness of PAM data from many research and governmental monitoring activities.

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2016-2018

Description:
Background: Tethys is a BOEM-co-funded, National-Oceanographic-Partnership-Program passive acoustic monitoring metadata database system designed to organize and store acoustic metadata (http://tethys.sdsu.edu/ ; see also Tethys (2013)) . The data schema (rules that govern how data is organized) were designed to permit representations of acoustic metadata that are comparable across long time frames by providing a consistent format. A set of schema have been developed for describing instrumentation, effort, detections and localizations. In addition to the standard reporting fields, the schema permits the addition of user-defined information, thus letting PAM practitioners define their own information.

Tethys is currently used for the management of the U. S. Navy's fleet data recorded on high frequency acoustic recording packages (HARPs) in the Cherry Point Operating Area, Jacksonville Range Complex, Southern California Offshore Range, The Northwest Range Training Complex, Gulf of Alaska Temporary Maritime Activities Area, Hawaii Range Complex, and Mariana Islands Range Complex. Tethys incorporates the expertise of PAM personnel at NOAA Alaska, Northeast, Pacific Islands, Southeast, and Southwest Fisheries Science Centers as well as PAM experts at Scripps Institution of Oceanography and San Diego State University. As an organizational level database, Tethys is designed to meet the needs of groups of users within one or several organizations.

Objective: The objective of this study is to advance the state of development of Tethys metadata standard and accompanying Tethys user software to facilitate the generation

of metadata documenting of PAM data sets in a manner that best meets the needs of the wider scientific and other PAM user communities.

Methods: Through dialog with the PAM community (scientific and other users), including but not limited to present Tethys users, and with close cooperation with the Acoustical Society of America this study will:

1. expand or otherwise modify the data schema according to the expressed needs of the PAM community and with the intent of arriving at a community-wide metadata standard;

2. enhance the client libraries to provide additional data analysis and reporting facilities;

3. identify bottlenecks in performance as the existing databases continue to grow in size (Code will be restructured to ensure smooth operation as we move to larger data sets.);

4. test and refine the interface using localization data collected by newly installed localizing HARPs in the Southern California Range Complex, from other U. S. Navy projects, and any other large data collection efforts that can be utilized; and

5. develop role-based security administration (e. g. contributor that can submit data or revisions, analyst that query data, administrator with privileges to remove data, etc.) for implementation   when Tethys runs in secure-server mode.

Revised Date: June 4, 2015

References:
Marques, T. A., Thomas, L., Ward, J., DiMarzio, N. and Tyack, P. L. (2009). Estimating cetacean population density using fixed passive acoustic sensors: An example with Blainville's beaked whales. J. Acous. Soc. Am. 125, 1982-1994, doi:10.1121/1.3089590.

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Roch, M. A., Baumann-Pickering, S., Batchelor, H., Hwang, D., Sirovic, A., Hildebrand, J. A., Berchok, C. L., Cholewiak, D., Munger, L. M., Oleson, E. M. et al. (2013).

Tethys: a workbench and database for passive acoustic metadata. Oceans 2013, 5 pp.

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Central and Eastern Gulf of Mexico

Administered By: Headquarters

Title: How Varying Ocean Temperature and Sea State Affect
                              Received Sound Pressure and Sound Exposure Levels in the
                              Central and Eastern Gulf of Mexico

BOEM Information Need(s) to be Addressed: The possible adverse effects of
acute and chronic exposure to marine animals of sounds generated by offshore energy
development activities (seismic surveying, pile driving, shipping, etc.) is a factor in
BOEM's environmental impact assessments and an important consideration in BOEM's
compliance with the MMPA and ESA. Rules for operators to mitigate adverse effects
such as mandated exclusion zones, e. g. a requisite distance from seismic surveying
ships depend upon estimates of the amplitude of generated sounds as a function of
distance from their sources. Improved knowledge of how amplitude can vary due to
spatial and temporal variation in the physical properties of the water through which the
sound propagates will facilitate better establishing the exclusion zones.

Approx. Cost: (in thousands) $1,800   **Period of Performance:** FY 2016-2018

Description:
Background: Determining how sound propagates in the ocean is a complex problem
made so by the multiplicity of physical factors determining the acoustical optics of the
ocean. The irregular and changing shape of the sea surface, the presence or absence of
sea ice, the shape and composition of the sea floor, and the time and space varying
temperature, salinity, and pressure of the water all determine how sound generated
somewhere will propagate to somewhere else. Over many past decades, sophisticated
models of ocean acoustics have been developed to both analyze and predict sound
propagation. The practical application of these models may be limited by how well the
models capture the essential physics of sound propagation but are more severely limited
by incomplete knowledge of the above-mentioned physical factors in the ocean area of
interest. Typically, greatly oversimplified conditions are the inputs into the models. For
example, a single profile of the vertical temperature, a temperature-salinity relation, and
a mean water depth may be all that is used to initialize a sound propagation model.

If BOEM created a mandatory exclusion zone around seismic surveying ships to limit
received sound exposure levels of near-by marine mammals to, say, 185 db, the size of
the zone would be determined by estimated typical sound propagation through the zone.
But if the seismic surveying ship were in water with temperature structure varying
greatly in time and space over the duration of the survey, the resultant animal exposure
may be significantly different than what is regarded as typical. How different the
exposure could be given known oceanic variability is the subject of this study.

The Gulf of Mexico is a place where seismic surveying is common and where the thermal structure varies significantly in space and time due to the meandering Loop Current and the strong , deep-reaching eddies shed by the current and drifting to the west through the central and western Gulf. The prominent perturbation of the mean temperature structure by these eddies may significantly alter the received sound pressure levels at specified locations from what they would be during unperturbed conditions.

The oil-spill modeling group at BOEM has a 10-year record of daily, analyzed, Gulf-of-Mexico temperature, salinity, velocity, and sea surface height fields with horizontal spatial resolution fine enough (6 km X 6 km) to resolve the meandering Loop Current and the mesoscale eddies it generates. These data could be combined with 3-D acoustic propagation models to investigate how much time- and space-varying temperature could change received sound pressure levels, i. e. calculate error bars on a mean condition.

The central and eastern Gulf of Mexico were chosen as the study area, because they are the part of the Gulf most directly impacted by the Loop Current and eddies shed by it. Although, the strong Loop Current eddies migrate westward into the western Gulf, the effect on sound propagation in the central Gulf should be comparable to that or a little greater than that in the western Gulf. An economy of computational effort is realized by omitting the western Gulf.

Objective: The objective of this study is to estimate the error in computing sound pressure levels and sound exposure levels from industry-typical air gun arrays due to the spatial and temporal variation of the 3-dimensional temperature field and sea state in the central and eastern Gulf of Mexico using a few different but appropriate 3-D propagation models to reduce the effect of model bias or weaknesses.

Methods: Hindcast analyses of 3-D sound propagation in realistic, spatially and temporally changing temperature and sea state fields will be performed using a few different 3-D propagation models selected for the deep-water central and eastern Gulf of Mexico. The analyses will calculate the corresponding, changing 3-D received sound pressure level and sound exposure level fields. The model sound sources will realistically simulate an industry-typical array of air guns used in 3-D seismic surveying. This will require one or more sound-source models. The model temperature fields will be the analyzed fields used by BOEM's oil-spill modelers and any other available fields of observed or modeled ocean temperature and sea state. The effects of changing temperature will be modeled separately from the effects of changing sea state. To the extent practical, the shape of the ocean bottom and the acoustical properties of the ocean bottom in the central and eastern Gulf will be built into the propagation models.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid-Atlantic

Administered By: Office of Renewable Energy Programs

Title: A Parametric Analysis and Sensitivity Study of the Acoustic
                         Propagation for Renewable Energy Sources and Projects

BOEM Information Need(s) to be Addressed: BOEM Office of Renewable Energy is required by the Endangered Species Act, Marine Mammal Protection Act, and the National Environmental Policy Act to assess the potential for impact for all of its projects. These assessments typically address the acoustic energy produced during the requisite activities for the construction and operation of these projects including: High Resolution Geophysical (HRG) surveys, construction noise, support vessel noise and operational noise. To date, these projects and analyses have been spread out in time and location and handled individually. However, as the number of projects increases, there is an increasing need to consistently and thoroughly manage the overall acoustic modeling effort. A prerequisite to managing this modeling is a clear understanding of the variability of the model's critical input parameters and how they constrain and drive the acoustic model results. This study will quantify those parameters and the modeling results they help to produce.

Approx. Cost: (in thousands) $275   **Period of Performance:** FY 2016 -2018

Description:
Background: BOEM prepares environmental compliance documents for renewable energy projects throughout the U.S. outer continental shelf (OCS). These compliance documents have thus far ranged from large-scale programmatic documents like the Programmatic Environmental Impact Statement (PEIS) for the Atlantic OCS Proposed Geological and Geophysical Activities (BOEM, 2014) to compliance documents for specific individual projects like the Final Environmental Impact Statement (FEIS) for the Cape Wind Energy Projected (BOEM 2009). Integral to these documents and their analyses is the need to conduct underwater acoustic modeling of the proposed activities in order to assess the potential for impacts to various marine species. To date, these analyses have been conducted by numerous contractors, who have often used different models, databases and approaches, which have resulted in varying results and levels of conservative assumptions. Additionally, this variability often makes it difficult to understand or determine if the calculations are overly conservative and therefore potentially, overly and unnecessarily restrictive to the proposed activity.

Many/most renewable energy projects consist of component activities that have common noise sources and occur in similar environmental conditions. Some of these commonalities include: 1) a limited number of sources many of which are universal (e.g., HRG surveys and vessel noises, 2) limited ranges of the source level (SL) and frequencies used by the sources (e.g., similar sources, types or even models are often used for HRG surveys), 3) activities occur on the continental shelf, in similar types of

shallow water areas (e.g., typically in water <50 m deep) with similar propagation modes, 4) activities occur in areas with similar bottoms types (e.g., typically sand, gravel, rock areas) with relatively strong acoustic reflection characteristics, and 5) activities may require similar oceanographic conditions (e.g., low sea states or wind speeds) in order to complete the activity.

The similarities of the sources employed during renewable activities, the environmental and acoustic characteristics of the areas where these source operate and the operational characteristics of the activities (e.g., survey types, duration of operations, depth of water in the operations area, etc.) indicate that the range of potential acoustic propagation fields and levels may be amenable to parametric analysis and characterization. By identifying and applying constraints to these parameters, modeling efforts will become more efficient for both industry and the government by standardizing the approaches to modeling and focusing attention only on those variables that could lead to adjustments in mitigation. Additionally, at the very least, this study should be able to quantify the ranges of the important parameters and provide an assessment of the sensitivity of the acoustic modeling output to these parameters.

Objectives: The objective of this study is to standardize modeling for sound propagation from activities associated with offshore renewable energy development.

Methods: The study will be conducted in two phases. Phase one will conduct a technical analysis of the acoustic propagation and modeling on the Atlantic continental shelf in order to provide: 1) recommendations for a consistently underwater acoustic modeling approach across the numerous renewable energy projects including the recommendation of models, databases and methodologies, 2) a baseline of expected range of expected modeling results including impact volumes around "typical" sources, 3) identify a baseline variability for the expected acoustic modeling results based on the variability of the critically modeled parameters, 4) results which can serve as a sensitivity study for inclusion in future compliance documents, and 5) identify sources or systems involved with renewable activities which have negligible potential for environmental impact. Phase two will use data collected from Block Island Wind Farm construction through the Real-time Opportunity for Development Environmental Observations (RODEO) to validate the model.

This study will:

1) Identify the best state-of-the-art underwater acoustic model(s) and databases to use for this analysis and explain the logic for this selection;
2) Identify the acoustic parameters critical as inputs to the models and databases identified in #1, and determine the potential ranges of these values for the Atlantic Outer Continental Shelf (OCS) Planning areas;
3) Identify and receive BOEM concurrence on the current and proposed acoustic threshold criteria (for both pressure and energy metrics, as well as for both Level A and B impacts) to be used in this analysis;
4) Identify and receive BOEM concurrence on the proposed detailed approach to conducting a parametric analysis of the critical parameters;
5) Conduct a parametric analysis by varying the input parameters identified in #2 through their full range of values when running the models and databases

identified in #1. This task will including an analysis of the results that provides a quantitative metric for each parameter;

6) Assess the overall sensitivity of the modeling output or potential impact results as a function of each critical parameter, including the identification of any natural groupings or divisions of the parameters (e.g., for example, if the SVP for north and south of Cape Hatteras could be grouped separately);

7) Validate the model using field observations collected through the RODEO project; and

8) Use data collected from other sound source verification studies of geological and geophysical survey equipment for model validation and verification.

Revised Date: January 9, 2015

<u>References:</u>

Programmatic Environmental Impact Statement (PEIS) for the Atlantic OCS Proposed Geological and Geophysical Activities (BOEM, 2014)

Final Environmental Impact Statement (FEIS) for the Cape Wind Energy Projected (BOEM 2009)

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North, Mid-, and South Atlantic

Administered By: Office of Renewable Energy Programs

Title: Commercial shipping and fishing vessel activity effects on seabird distribution and abundance on the Atlantic OCS

BOEM Information Need(s) to be Addressed: Understanding how anthropogenic factors may affect the distribution and abundance of seabirds will enable BOEM to refine its analyses of the impacts from activities related to renewable energy development.

Approx. Cost: (in thousands) $150   **Period of Performance:** FY 2016

Description:
Background: The process for identifying wind energy areas on the Atlantic OCS is aimed at facilitating the prioritization, rapid siting and leasing of new projects. Discussions during the Fish and Wildlife Service Marine Bird Science and Offshore Wind Workshop and the BOEM Atlantic Wind Energy Workshop in 2011 emphasized the importance of identifying bird "hot spots" and "cold spots." It is common knowledge that many seabird species follow fishing vessels to opportunistically feed on by-catch and this practice can influence many bird populations (e.g., Bicknell et al., 2013). It is also believed that these behaviors explain some of the observed avian hot spots on maps produced using data from the USGS Compendium of Avian Occurrence (Kinlan, et al. 2012). In Europe, the development of offshore wind has led to a reduction of commercial fishing activity within the foot print of wind facilities (Scheidat et al., 2011). Therefore, within wind energy areas with a history of commercial fishing, it is reasonable to assume that there will be a reduction in seabird numbers once a wind facility becomes operational and commercial fishing vessel activity is reduced. On the other hand, it is well known that some bird species are disturbed by commercial shipping traffic (Schwemmer et al., 2011). However, a formal statistical analysis of existing data on the Atlantic OCS is needed to support this assumption in BOEM's environmental review and interpretation of avian survey data. BOEM envisions working directly with NOAA or USGS through an interagency agreement.

Objectives: The objective of this study is to provide an understanding of how commercial shipping traffic and fishing vessel activity may contribute to shifts in distribution and abundance of seabirds around offshore wind facilities.

Methods: This study will incorporate existing data from three sources: 1) the USGS Compendium of Avian Occurrence; 2) Vessel Monitoring System (VMS) data; and 3) Automatic Information System (AIS). BOEM has acquired and processed five years of VMS data (2006-2010) and three years of AIS data (2009-2012) that spans the entire Atlantic OCS. Ten species are known to be influenced by the casting off of unwanted fish from fishing boats or boating traffic (black-legged kittiwake, herring gull, great black-backed gull, northern gannet, northern fulmar, common loons, common eiders,

common tern, Cory's shearwater, and greater shearwater) (Schwemmer et al., 2011; Bicknell et al., 2013; Veit and Perkins 2014), and the distributions of these species for the Atlantic OCS have been modeled in the avian compendium study. New statistical models will be developed and be used to predict the potential decrease in seabird abundance associated with reduced fishing vessel activity within the wind energy areas after commercial development. Another set of models will describe the distribution of species in response to changes in shipping traffic. These models will be used to predict shifts in seabird distribution due to future changes in shipping traffic described in BOEM's "Marine Vessel Traffic and Wind Energy Development Infrastructure on the OCS Risk Analysis."

Predicative accuracy of the models will be assessed with a variety of diagnostic and validation statistics. All model and maps and products will be peer-reviewed by the statistical and seabird experts. All maps will be versioned so that they can be updated, include detailed metadata, and made available for the Marine Cadastre and other public data portals.

Revised Date: May 13, 2015

References:

Bicknell, Anthony W. J., Daniel Oro, Kees C. J. Camphuysen, Stephen C. Votier, and Julia Blanchard. "Potential Consequences of Discard Reform for Seabird Communities." *Journal of Applied Ecology* (2013): n/a-n/a.

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Scheidat, Meike, Jakob Tougaard, Sophie Brasseur, Jacob Carstensen, Tamara van Polanen Petel, Jonas Teilmann, and Peter Reijnders. "Harbour Porpoises (Phocoena Phocoena) and Wind Farms: A Case Study in the Dutch North Sea." *Environmental Research Letters* 6, no. 2 (2011): 025102.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of ship traffic on seabirds in offshore waters: Implications for marine conservation and spatial planning. Ecological Applications 21:1851–1860.

Veit, R.R. and S. A. Perkins. 2014. Aerial Surveys for Roseate and Common Terns South of Tuckernuck and Muskeget Islands July-September 2013, Herndon, Virginia. OCS Study BOEM 2014-665. 13 pp.

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North, Mid-, and South Atlantic

Administered By: Office of Renewable Energy Programs

Title: Detection of Marine Species from High Resolution Aerial Vertical Photography using Automated Anomaly Detection Software

BOEM Information Need(s) to be Addressed: Multiple ongoing aerial surveys are being employed to collect data on the distribution and abundance of endangered species and seabirds in the wind energy areas off the east coast of the U.S. A recently completed BOEM study, Pilot Study of Aerial High-Definition Video Surveys for Seabirds, Marine Mammals, and Sea Turtles on the Atlantic OCS, is advancing this capability, however, there are still challenges with processing the large volume of images in an efficient and cost effective manner. Such data will improve density estimates and baseline assessments of sea turtles and smaller marine mammals, providing managers with better information to make decisions. This technology is also a first step toward automated survey technology using unmanned aircraft.

Approx. Cost: (in thousands) $390   **Period of Performance:** FY 2016-2018

Description:
Background: This study would improve anomaly detection capabilities to detect marine species from high resolution aerial survey imagery. The study would apply an innovative anomaly detection software program to process an existing aerial survey imagery from the Massachusetts Wind Energy Area dataset, and train the system to detect marine mammals, sea turtles, and sharks. The study would compare automated vs. observer detection capabilities, and evaluate these technologies for their potential use in semi-automated survey strategies. If effective, these technologies could be adopted by existing aerial surveys at little extra operational cost, and provide high-quality data to complement a wide range of research interests.

Aerial surveys are widely used to assess the distribution and abundance of marine life in order to comply with a variety of regulatory requirements. Their effectiveness is dependent upon the methods used to detect, identify, count, and monitor species of interest. Recent advances in both still and video camera high-resolution image collection, makes a variety of image based platforms attractive for both assessment and mitigation surveys around offshore energy sites. However, the analysis of such imagery is challenging. Trained photo-analysts can be employed, but the work is time consuming and tedious, with the potential for analyst fatigue and bias. Anomaly detection software has been tried, but different methods have produced either excessive "false positives" (sighting detections where there are none) or false negatives (missed sightings of animals clearly in the images). Recent work on this problem has identified the need for further testing and development of this software to reduce these problems. Preliminary tests have been conducted to assess the ability of the software to detect anomalous characteristics when marine species were sub-surface, which demonstrated the

capability of the software to detect a range of different sized species at depth. Additional work is needed to make adjustments to the software to accept images of a larger size, eliminate interference from bright sun glares by using a special filter, and reduce the number of false-positives by training the classification algorithm to recognize and eliminate them.

<u>Objectives</u>: Using an already collected extensive aerial survey image dataset, the objectives would be to:

1. Determine the effectiveness of new multi-layer anomaly detection software to identify the presence or absence of animals in vertical photographs with natural "clutter" (glare, whitecaps, wave patterns).

2. Refine and "train" the anomaly detection software to detect turtles, marine mammals, and sharks from "cluttered" images.

3. Provide comparisons of automated vs observer detection capabilities.

4. Optimize the software so that it can function in near-real time.

<u>Methods</u>: The project is proposed to occur in two phases.

Phase 1: Collection of the vertical photography database for use in this project is already being supported through a Massachusetts Clean Energy Center (MassCEC) and BOEM funded contract: Field Studies of Whales and Sea Turtles for Offshore Alternative Energy Planning in Massachusetts. MassCEC has agreed to make the database available for this proposed work. The vertical image database contains over 100,000 high-resolution digital still images totaling 850 GB. This database has been manually analyzed by observers, and all sightings of fish, sharks, turtles, marine mammals and fishing gear have been recorded. The database will be processed through anomaly detection software developed by Aero Surveillance (ASI). Occurrences of false/true positives, and false/true negatives of detected anomalous sightings will be recorded to test the strength of the detection software. In order to compare automated vs manual detection rates of vertical images for potential independent measures of distribution and abundance, we will test the software's ability to detect anomalies, distinguish between positive and negative anomalies, 'learn' detection skills by training the, and distinguish between marine biota.

Phase 2: To further enhance the processing speed to be able to accommodate very high resolution (> 10 Mp) imagery in a real-time fashion, the core components of the algorithm (so-called inner loops) would need to be further optimized to take advantage of the latest image/graphics processing hardware technologies, for example the highly parallelized general purpose graphics processing units (GP-GPUs). For processing speed in the marine environment, the parameters and the classification database need to be re-tuned and optimized.

Revised Date: December 20, 2014

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North Atlantic

Administered By: Office of Renewable Energy Programs

Title: Impact Assessment and Mitigation of Offshore Wind
Turbines on High Frequency Coastal Oceanographic Radar

BOEM Information Need(s) to be Addressed: BOEM requires thorough environmental review and address of public concerns for its environmental assessments related to research and commercial wind lease issuance along the Outer Continental Shelf (OCS). Pursuant to NEPA and CEQ regulations, BOEM must consider potential user conflicts associated with issuing leases and approving site assessment activities in certain areas of the OCS. Currently, BOEM wind energy areas offshore Rhode Island/Massachusetts, Virginia, and North Carolina pose potentially negative impacts to the U.S. High Frequency (HF) Radar Network, which falls under the auspices of the U.S. Integrated Ocean Observing System (IOOS). With the start of construction in the summer of 2015 of the first offshore wind turbines near Block Island, Rhode Island, BOEM may now assess the impact wind turbines may pose on the HF coastal oceanographic radar network used operationally by the U.S. Coast Guard for search and rescue and by NOAA for oil spill monitoring and response, among many other societal needs. Presently there are five continuously operating HF radars that collect data covering areas in and around the proposed Block Island Wind Farm. Partnering with the IOOS Program Office, BOEM will be able to obtain in situ measurements from nearby HF radars during wind turbine operation at Block Island to quantify adverse impacts of rotating wind turbines on HF radars. Applying in situ data to the creation and validation of algorithms for mitigation of the negative impacts of wind turbine blade interference to HF radars will advance the interagency coordination needed for thorough NEPA analyses and review. Real-time evaluation and optimization of the mitigation methods generated from this study will assess HF radar signal degradation and interference from wind turbine sources.   The proposed impact study is needed prior to and post wind turbine installation in order to accurately investigate and mitigate potential radar interference by wind turbines and identify possible solutions that allow the coexistence of wind energy facilities and radar infrastructure and services.

Approx. Cost: (in thousands) $350   **Period of Performance:** FY 2016 – 2017

Description:
Background: Recent simulations of offshore wind turbine interaction with HF coastal radar operation (Teague and Barrick, 2012; Ling et al, 2013) indicate that rotating turbine blades cause interference with HF radar data that requires mitigation techniques for optimal use of these data. The signature and impact of turbine blade rotation on HF radar data processing have not yet been characterized sufficiently from real-world situations, and adequate simulation data have been undertaken only recently. It is known from past studies and HF radar measurements that wind turbines within the field of view have negative impacts on the received signals (Ling, 2013; Teague and

Barrick, 2012). These degrade ocean current and wave processing and their output data products. Degradation can be so severe as to render data useless. This will first be felt by the HF radar systems on Block Island, because the turbine placement will be close to shore (within 6 km), where the effects of the wind turbines will be most impactful on the HF radars. Simulations of turbine impacts must be refined to include details of actual turbine construction materials and operating parameters. More importantly, these simulations must be augmented by incorporation of real-world data under a variety of conditions. This will allow BOEM to assess the impacts of wind turbines on HF radar for environmental and engineering review and the development of mitigation techniques required for unimpeded U.S. Integrated Ocean Observing System (IOOS) HF radar network operations.

Objectives: The overall objective of this study is to understand the effects of offshore wind turbines on HF radar operations. Specific objectives include the following:

- Data will be collected by the radars when the turbines are operating, in order to observe and assess the severity of the impacts. Based on these signals, work will begin on development of algorithmic methods to mitigate their impacts.

- The effectiveness of mitigation methods will be analyzed and method revisions will start, including changing the radar waveform (e.g., the repetition frequency); filtering based on knowledge of the bearing of the fixed turbine locations and attempts to notch out these angles from current and wave algorithms; and use of turbine-mounted calibrating beacons to optimize turbine echo spur excision.

- Real-time beta testing of derived methods for optimization of operational implementation will be conducted.

Methods: This study will conduct in-depth research into wind turbine operation, with data collection of specific operating parameters, e.g., turbine blade rotation rates, construction materials, and sizes of turbines and blades. In order to better simulate offshore wind turbine operations, IOOS HF radar technical staff, their regional representatives, and industry partners will exchange information directly with wind turbine industry engineers in order to improve or refine simulations using currently existing tools and methods.

The previously developed Numerical Electromagnetic Code (NEC) will be expanded to reflect real-world parameters for simulations of wind turbine rotation effects, including frequencies other than the 13.5 MHz used in prior simulations. These improved and expanded simulations will inform the evolution of field tests and interference mitigation methods. Turbine echoes affect the received signals of all HF radars in much the same way, regardless of brand because all use the same waveform (FMCW).

Field testing of HF radar in the vicinity of offshore wind turbines must be conducted to accurately assess and validate mitigation algorithms. HF radar will collect data in coastal areas where offshore wind turbines are currently in operation, e.g., Block Island, Rhode Island. The length of time required for adequate characterization of the varying conditions that may exist is about two months. Sufficient time must account for

variations in wind conditions responsible for changes in turbine blade speed, pitch, and orientation to the radar; for variations in wave and ocean current conditions for examination of differences in Bragg and second-order sea echo characteristics in the presence of radar interference; and for changes in system configurations. All levels of data products from HF radar will be kept for analysis during the entire study. Data from the following US IOOS HF radar sites will be available for processing and analysis of wind turbine impacts:

- Block Island, RI (2 radars) (operated by Univ. of Rhode Island & Rutgers)
- Montauk, NY (operated by Univ. of Rhode Island)
- Misquamicut, RI (operated by Univ. of Rhode Island)
- Martha's Vineyard, MA (operated by Rutgers Univ.)
- Nantucket Island, MA (operated by Rutgers Univ.)
  (*Note that each radar on Martha's Vineyard and Nantucket Island is capable of 200 km ranges, hence their inclusion here.)

References:

Ling et al, 2013 , DOE Study DEEE0005380, "Assessment of Offshore Wind Farm Effects on Sea Surface, Subsurface and Airborne Electronic Systems", Univ. of Texas-Austin.

Teague and Barrick, 2012, "Estimation of Wind Turbine Radar Signature at 13.5 MHz," IEEE/MTS-Oceans Conference Proceedings.

Revised Date: May 4, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Atlantic

Administered By: Office of Renewable Energy Programs

Title: Literature Review of Wind Energy Facility Impacts to
Local Meteorology

BOEM Information Need(s) to be Addressed: This study will inform the impacts of wind energy facilities on local meteorology. Commercial wind facilities could result in localized changes in the microclimate of an area. This type of localized alteration has potential environmental consequences that need to be analyzed as part of the NEPA process.

Approx. Cost: (in thousands) $45   **Period of Performance:** FY 2016

Description:
Background: During the public comment periods of the Cape Wind Energy Project the public expressed concerns that Wind Turbine Generators (WTG) can create their own microclimate in Nantucket Sound. A microclimate is a small, local area having distinct weather or weather effects. Studies of other wind energy facilities have been conducted that validate this concern. The studies conclude that when local meteorological conditions are favorable a microclimate can occur. Impacts vary from cloud/fog formation to temperature changes and precipitation occurring. Artificial vertical mixing in the atmosphere caused by the WTGs can form a microclimate. The formation of a microclimate has the potential to impact commercial and recreational activities and navigation in the vicinity of a wind energy facility.

Objectives: The objective of this study is to provide an evaluation of the potential meteorological impacts due to the presence of a wind energy facility. This literature review will summarize the impacts of a wind energy facility on local meteorology and the conditions conducive to creating a microclimate within a wind turbine array in order to properly analyze the environmental consequences resulting from the installation of a wind energy facility.

Methods: This study will: 1) identify literature that addresses the topic of wind energy facility impacts on local meteorology; 2) identify the conditions conducive to creating a microclimate within a wind turbine array; 3) summarize the likely impacts in the offshore environment; and 4) identify potential options to mitigate local effects.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Atlantic

Administered By: Office of Renewable Energy Programs

Title: Quantifying the Changes in Air Pollution from Offshore
                          Wind Development for the Atlantic Region

BOEM Information Need(s) to be Addressed: This proposed work applies state-of-the-science electricity market and atmospheric models across temporal and spatial scales to fully analyze the air quality impacts of energy choices by internalizing environmental externalities. The analysis will estimate changes in air quality and climate impacts due to changes in electricity generation associated with different offshore wind development scenarios. Design of a sustainable U.S. energy mix requires a prior knowledge of environmental impacts that can only be calculated by employing a variety of modeling tools. BOEM will use the results to analyze the benefits of renewable energy development in environmental assessments.

Approx. Cost: (in thousands) $450   **Period of Performance:** FY 2016-2018

Description:
Background: Energy consumption is the largest source of emissions that impact air quality (e.g., SO_2, NO_x, primary $PM_{2.5}$) and climate, (e.g., N_2O, CO, CH_4 particulate sulfate and black carbon). The electric power sector is one, if not the largest, contributor to these emissions out of all the energy sectors. Smart and sustainable energy system design and operation that considers emissions-related environmental impacts can be used to cost effectively reduce ambient concentrations of a variety of pollutants, ultimately minimizing human exposure and the associated negative health outcomes. Conventional power generation expansion planning and electricity dispatch minimize cost subject to reliability requirements. Conversely, traditional evaluation of air quality management strategies occurs separately from considerations of the evolution of the U.S. energy system, or of long-term impacts that energy policies will have on sectors such as electricity. A variety of modeling tools operating on different spatial and temporal scales are used to address energy systems, manage air quality, and assess climate independently. However, air quality, climate, and energy (ACE) are all strongly intertwined.

Objectives: The objective is to develop a clearer quantitative understanding of the environmental and health impacts of offshore wind development in the near term. The study will provide an improved integrated modeling platform to help ensure U.S. energy policy is sustainable and that tools available to policymakers respond appropriately to proposed offshore wind development, air quality rules, climate adaptation and mitigation policies and remain robust even as the climate changes. This integrated modeling platform can be extended to other regions of the United States.

Methods: The Day-Ahead Locational Market Clearing Prices Analyzer (DAYZER) model's refined electricity sector emissions will be processed using the Sparse Matrix

Operator Kernel Emissions (SMOKE) model. SMOKE output will be used as input for EPA's Community Multi-scale Air Quality (CMAQ) model to predict and quantify air quality impacts. Preliminary analysis of alternative energy scenarios, suggests development of offshore wind can reduce summertime emissions of NOx and fine particles by 10% (July monthly basis). Ambient concentrations of ozone, particulate sulfate and black carbon, important regional climate forcers, change dramatically at the surface and aloft, where radiative forcing and regional climate impacts can be substantial.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid-Atlantic

Administered By: Office of Renewable Energy Programs

Title: Sediment Mobility on the Mid-Atlantic Continental Shelf

BOEM Information Need(s) to be Addressed: Knowledge of sediment transport events within a proposed wind-turbine site is critical for design conditions that accurately account for seabed scour assessment and analysis of sediment mobility. Seabed scour that may result from the placement of a large wind facility, as proposed in the Virginia Wind Energy Area, could lead to regional scour and alteration of the benthic habitat. Understanding the dynamic processes in this region will aid in the evaluation of potential alterations to the benthic habitat and potential adjustments to the overall design of the wind facility.

Approx. Cost: (in thousands) $800   **Period of Performance:** FY 2016-2018

Description:
Background: In 2014, BOEM received an application from Dominion Resources, Inc. (Dominion) for a 12-megawatt (MW) offshore wind technology testing facility located approximately 24 nautical miles east of Virginia Beach, VA. This technology advancement project will consist of two 6-MW wind turbine generators, an alternating current submarine cable interconnecting the wind turbine generators, a submarine transmission cable to shore, and an underground cable that will interconnect the wind turbines with existing power infrastructure located within Virginia Beach, VA. Additionally, Dominion proposes to install three stand-alone metocean instrumentation platforms linked to the wind turbine demonstration project in order to collect real-time oceanographic measurements. Preliminary data submitted to BOEM from Dominion and analysis by the U.S. Geological Survey (USGS) of sediment mobility and shear stress within the Mid-Atlantic Bight indicate that the proposed wind-turbine project area offshore Virginia is highly dynamic, with wind-waves and storm-driven currents producing sediment mobility events as frequently as weekly during winter months.

Although Dominion has submitted preliminary geophysical data to BOEM for engineering and environmental assessment of their proposed wind-turbine technology testing project, additional data addressing the energetic nature of the sediment within the project area are needed to evaluate the feasibility of siting operational wind turbine generators in this dynamic environment. The data provided by this study, in combination with Dominion geophysical project data, will better quantify sediment mobility offshore the Virginia coast to evaluate the environmental impacts and stability of offshore wind energy development.

Sediment mobility refers to the degree to which the seafloor can be reworked by oceanographic forces, and therefore depends on sediment type, bed morphology, and the stresses applied to the bed from ocean waves and currents. None of these, however, are adequately constrained for the continental shelf of Virginia, though storm conditions

are estimated to be capable of mobilizing sediment there on a weekly basis during the winter (Dalyander et al. 2013). To evaluate sediment mobility requires that the shear stresses that the flow exerts on the seafloor are well understood for conditions that range from fairweather to extreme storms. For this purpose, numerical models have been developed (i.e. Dalyander et al. 2013), but model parameters have not been tested via comparison to measured wave, current, and shear stress parameters for the coastal ocean of Virginia. To provide data suitable for choosing model parameters would require the deployment of instrumentation very near the seabed (bottom few meters), including instruments for measuring current velocities at high frequencies, and optical or acoustic proxies for suspended sediment concentration.

Characterizing sediment mobility also requires grain size data, but sediment texture offshore of Virginia has only been sampled on a sparse grid, and the data indicates that sediment texture on this continental shelf ranges from sands to clayey silts (McMullen et al. 2011). Besides measuring sediment grain size, sediment cores can also be used to evaluate the erodibility of the sediment, defined as the degree to which a seabed will erode when subjected to a constant bed shear stress (see Dickhudt et al. 2009). Particularly useful for constraining the degree of consolidation for muddy beds, erodibility measurements can be used to choose parameters for sediment transport models. Finally, spatial variations in sediment texture should be examined in the context of the morphology of the seafloor, including bedforms at multiple scales.

Objectives:

1. Characterize sediment texture and erodibility on the Virginia continental shelf in the region of future wind farm installations. Samples will characterize variability in sediment texture and erodibility at appropriate spatial scales.

2. Relate oceanographic waves and currents to bed shear stresses and sediment mobility. Near-bed instrumentation from a few locations will provide observations of suspended sediment concentrations and near-bed turbulent stresses.

3. Refine numerical modeling tools for estimating sediment mobility in terms of the degree to which the seabed is disturbed by wave and current energy. Model parameters will be chosen based on insights from Objectives 1 and 2 and then be applied to a range of oceanographic conditions.

Methods:

1. Sediment coring expeditions will obtain grain size data across an appropriately dense spatial grid. Coring should be done via vibracores and boxcores. Erodibility measurements will then be used to characterize the degree of consolidation (for muddy sediment) and bed armoring (for mixed beds and silts / sands). Phasing: Sediment coring will occur early in the project, in coordination with any Dominion geophysical surveys planned for their wind technology demonstration project. Products: This study will provide a database for sediment grain size and erodibility for the Virginia continental shelf, providing invaluable information for future development offshore of Virginia.

2. Near-bed instrumentation will be deployed via tripod-like platforms at two sites, aligned in an across-shore transect, and placed over distinct substrate types. This field campaign will provide near-bed measurements of turbulent stresses and suspended sediment concentrations and provide critical data for choosing parameters for the numerical model. Phasing: Tripods will be deployed during winter to maximize the chance of observing energetic storms. Products: The bottom boundary layer study will provide time-series measurements of near-bed turbulence and suspended sediment fields.

3. A three-dimensional (3D) numerical model will be developed to represent the hydrodynamic and suspended sediment fields for the continental shelf offshore of Virginia, with a setup similar to that described in Dalyander et al. (2013), but with higher spatial resolution. Phasing: Early in year 1 of this study, the model will be used to conduct sensitivity analyses to identify key model uncertainties. Then, in year 2, the 3D model will be refined based on insights from the tripod data and the bottom boundary layer model. In year 3, the 3D model will be used to evaluate sediment mobility for a range of typical oceanographic and storm conditions. Products: The model output will include a highly resolved characterization of the hydrodynamics, suspended sediment, and bed mobility fields.

Revised Date: January 8, 2015

References:

Dalyander, P.S., B. Butman, C.R. Sherwood, R.P. Signell, and J. Wilkin. 2013. Characterizing wave- and current-induced bottom shear stress: U.S. middle Atlantic continental shelf. Continental Shelf Research, 52: 73 – 86.

Dickhudt, P.J., C.T. Friedrichs, L.C. Schaffner, and L.P. Sanford. 2009. Spatial and temporal variation in cohesive sediment erodibility in the York River estuary, eastern USA: A biologically influenced equilibrium modified by seasonal deposition. Marine Geology, 267(3), 128-140.

McMullen, K.Y., Paskevich, V.F., Poppe, L.J. 2011. GIS data catalog (version2.2), in: Poppe, L.J.,

Williams, S.J. and Paskevich, V.F. (Eds.), 2005, USGS East-Coast Sediment Analysis: Procedures, Database, and GIS Data, U.S. Geological Survey Open-File Report 2005-1001.

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   South Atlantic

Administered By: Office of Renewable Energy Programs

Title: Spatial Ecology, Movement Patterns, and At-sea Habitat
Use of Brown Pelicans: Addressing Needs for Renewable
Energy Development

BOEM Information Need(s) to be Addressed: Information is needed to assess potential interactions between nearshore seabirds and renewable energy structures in the region. One species that ranges widely in the region, is of conservation concern, and that would serve as the best model to assess such interactions is the Eastern Brown Pelican. The species breeds throughout the region and forages out to 30 km from shore but to date there have been no studies conducted along the Atlantic coast at the appropriate temporal or spatial scales on at-sea habitat use or seasonal movements. The opportunity to model potential interactions between this nearshore seabird and structures deployed for renewable energy development is therefore weak.

Approx. Cost: (in thousands) $1,000   **Period of Performance:** FY 2016-2019

Description:
Background: This study addresses information needs for the potential overlap between offshore energy activities in the South Atlantic Planning Area (SAP) and use areas of nearshore seabirds that breed and winter there. The proposed study also would complement an ongoing study in the Gulf of Mexico (IAA no. M12PG00014; Eastern Brown Pelicans: Dispersal, Seasonal Movements, and Monitoring of PAHs and Other Contaminants in the Northern Gulf of Mexico) being conducted by USGS in which Brown Pelicans are being tagged with satellite transmitters in the Gulf's Western, Central and Eastern planning area to assess at-sea habitat use and movement patterns in relation to oil and gas development. To date, approximately 75 breeding pelicans were successfully satellite-tagged and > 200k locations collected, clearly demonstrating the feasibility of conducting research to address large-scale studies of risk assessment.

Brown Pelicans have been understudied in the SAP, although USGS has successfully conducted research on the species here. Nonetheless our understanding of population trends, reproductive success, and habitat use at sea is very limited (Shields 2002, Jodice et al. 2007). There are an estimated 6,000 – 8,000 pairs of Brown Pelicans nesting in SC, GA and north FL, and > 50% of these nests occur in SC (Jodice et al. 2013).

The potential for an overlap between use areas of Brown Pelicans in the marine environment and proposed or existing BOEM activities (e.g. offshore wind energy development) appears to be substantial in the SAP. Colonies are distributed regularly throughout the coastal area of the SAP (i.e., they are not clumped in one or two areas; Jodice et al. 2013). Both species regularly forage in nearshore waters (0 – 10 km from shore) but also out to 50 km. The species also occurs here during migration and wintering periods. Our understanding of fine-scale habitat use is, however, very limited

and therefore we cannot readily determine the probability of actual exposure to any factors at sea until we can assess foraging ranges, movement patterns, and migration paths at the resolution available via GPS tracking. Similar data are being collected on pelagic and nearshore seabirds in other regions along the Atlantic to address similar issues (e.g. mid- and north Atlantic studies of loons, seaducks and gannets) but to date have not been initiated in the SAP.

Objectives: The proposed study will determine detailed at-sea habitat use, movement patterns, and migration paths of adult Brown Pelicans throughout the SAP and throughout the annual cycle. By tagging birds at breeding colonies, the spatial connection between at-sea locations and colonies can be assessed, and hence evaluate risks to each colony.

Methods: Approximately 100 adults will be captured and marked at nesting colonies throughout the SAP (and possibly immediately north of the SAP in NC). GPS satellite transmitters of appropriate size and type will be deployed on each bird. Assuming standard performance of satellite units, location data will be transmitted on a daily basis for $1-2$ years. Seasonal home range maps will be developed for each individual and core use areas also will be mapped for the population. Preferred habitats will be determined via standard statistical and geographical modeling approaches. Migration routes will be mapped. The above data will be used to determine high, moderate and low use areas at sea throughout the year. Movement and use data will be layered with available marine habitat data, wind and current data, and environmental data to provide individual- and colony-based risk assessments for each species.

Revised Date: March 26, 2015

References:

Shields, M. 2002. Brown Pelican (Pelecanus occidentalis). In: The Birds of North America, No. 609, A. Poole and F. Gill, Eds. The Birds of North America, Inc., Philadelphia.

Jodice, P.G.R., T.M. Murphy, F. J. Sanders, L. Ferguson. 2007. Longterm Trends in Nest Counts of Colonial Nesting Seabirds in South Carolina, USA. Waterbirds 30:40-51.

Jodice, P.G.R., J. Tavano, W. Mackin. 2013. Chapter 8: Marine and coastal birds and bats. Pages 475-587 In: Michel, J. (ed.). South Atlantic information resources: data search and literature synthesis. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-01157.

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North, Mid-, and South Atlantic

Administered By: Office of Renewable Energy Programs

Title: Standards for the Collection and Analytical Processing of
                         Subsurface Core Samples

BOEM Information Need(s) to be Addressed: BOEM needs to develop standards
for adequate and appropriate spacing, density, collection, and post-collection (i.e.
laboratory analytical) treatment of vibracores, including final disposition of core
samples and data, as methods for aiding in the identification of historic properties
offshore the Atlantic. These standards need to be communicated by augmenting
BOEM's *Guidelines for Providing Geological and Geophysical, Hazards, and
Archaeological Information Pursuant to 30 CFR Part 585.*

Approx. Cost: (in thousands) $750   **Period of Performance:** FY 2016-2017

Description:
Background: Although vibracore collection (and similarly-executed boring) is one of
multiple subsurface sediment sampling techniques, it is unique with respect to its utility
as a direct-sampling method that may be used in the identification of submerged
archaeological sites. As one of the few subsurface sediment sampling techniques that are
minimally invasive to these resources, vibracoring results in the collection of an intact,
generally 4-inch diameter by (up to) 40-foot cylindrical sample of sediments from the
seabed, which may then be subjected to further onshore analysis.

But questions remain to be answered with respect to applying this technology to the
identification of historic properties for the purposes of Section 106 of the National
Historic Preservation Act and under the Renewable Energy regulations at 30 CFR 585.
First, consideration must be given to what constitute appropriate and adequate
sampling strategies. Second, given adequate direct sampling is conducted, appropriate
and consistent treatment of the collected cores must include subjection to certain
laboratory and other analyses, which may point to non-artifact indicators of human
habitation (including, for example, macro-sedimentary analyses of bone and shell
concentrations and burned materials, grain size analysis, and geochemical analysis of
percentages of total organic carbon of zinc and manganese). Standards must be
developed for differentiating terrestrial stratigraphic sequences that are not
archaeologically sensitive from those that are. Standard operating procedures for the
handling and archiving of cores and coring materials (e.g., subsamples) also should be
established and observed, including submission of data resulting from geological
borings. Finally, standards for reporting of results must be shared with developers to
ensure the highest quality data are submitted with plans and thus utilized in BOEM's
decision-making process.

Participants at BOEM's 2012 Wind Energy Workshop – Archaeology tract discussed
these questions and issues, but many of Europe's submerged prehistoric archaeologists

speaking with the benefit of wind energy experience concluded that no consistency exists on the European side of the Atlantic with respect to analyses utilized. They also commented that, where lacking, standard operating procedures are desirable and would be beneficial. The lack of consistent application of standards in the European Atlantic and the question of applicability of Stright's 1986 study *(Criteria distinguishing archaeological deposits from natural sedimentary deposits in the Gulf of Mexico coastal region)* to the Atlantic region justifies the continued consideration of this topic within the geographic confines of the Atlantic OCS. Consideration also should be given to what variability may exist therein, identifying where different study regimes on the Atlantic OCS are warranted.

It is anticipated that the methods established by this study will become consistent treatment for Atlantic region core collection and borings conducted in support of plans and that analytical results and photographs of cores will be part of the Outer Continental Shelf Interactive Registry of Archaeological Surveys (OCSIRAS), which is also under development by BOEM at this time. Inclusion of core analyses and photographs in OCSIRAS will ensure that archaeologists working in BOEM's various regions will be able to see and interact with these data.

Objectives: The objective of the study is to develop and test standards for adequate and appropriate spacing, density, collection, and post-collection (i.e. laboratory analytical) treatment of vibracores, including final disposition, as methods for aiding in the identification of historic properties offshore the Atlantic.

Methods: (1) From applicable previous investigations into the subject, this study will synthesize successful methodologies and derive a focused research design. (2) The research design will guide the development of draft standards for using subsurface seabed sediment samples as a method of identification of archaeological resources offshore the Atlantic, including a standard suite of primary-level laboratory analyses and a possible suite of secondary-level analyses dependent upon the results of the first. (3) These methods will then be applied to newly-collected core samples and will be tested for applicability within a developer-conducted framework. (4) Results of the testing will be incorporated into final standards that, if appropriate, BOEM may then consider incorporating into its *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585*.

Reference:

Stright, M.J. 1986. Human Occupation of the Continental Shelf During the Late Pleistocene/Early Holocene: Methods for Site Location. In *Geoarchaeology*: Vol 1, No. 4, 347-264.

Revised Date: April 23, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North Atlantic

Administered By: Office of Renewable Energy Programs

Title: Testing an Offshore Buoy-based Nanotag Receiving Station

BOEM Information Need(s) to be Addressed: Information on the offshore movements of birds and bats is essential for understanding the potential for these taxa to encounter conflicts with renewable energy development in high priority offshore areas, for NEPA assessments, and for Section 7 Consultations with the U.S. Fish and Wildlife Service.

Approx. Cost: (in thousands) $250   **Period of Performance:** FY 2016-2017

Description:
Background: Since FY2013 BOEM and USFWS have been collaborating on a project that verified a relatively recent technology, Nanotags, for tracking movements of coastal birds and bats. In 2013 and 2014, we operated a network of eleven land-based automated radio telemetry stations at coastal sites ranging from Cape Cod, MA to Long Island, NY. These stations have been successful in tracking bird and bat movements within the region, with upwards of 8.5 million detections of 500 different birds and bats over the past two field seasons (May–Nov), however, the detection range of onshore stations is limited (<10–20 km) to targets flying at relatively low (<50 m) altitudes. Therefore, expansion of the automated radio telemetry array to include buoy-based receiving stations would fill key coverage gaps in high priority offshore areas. This increased coverage would improve our ability to accurately estimate movement paths of birds and bats in offshore areas using movement models that are currently being developing for the land-based radio telemetry array.

This study would test the effectiveness of utilizing a moored buoy as an instrument platform for automated radio telemetry equipment for tracking birds and bats instrumented with digital VHF ("Nanotag") transmitters. Strategic deployment of buoy-based radio telemetry stations would fill in key coverage gaps within targeted offshore areas that are beyond the detection range (10–20 km) of existing land-based automated radio telemetry towers to track birds and bats flying at rotor-swept altitudes. This will allow for continuous, around-the-clock and all-weather monitoring of the movements of bird and bats through high-priority offshore areas. The buoy-based radio telemetry station will be compatible with the growing MOTUS network, a collaboration of researchers in the U.S. and Canada that are using Nanotag technology to track the movements of thousands of birds and bats across the Atlantic flyway.

Objectives: The objective of the study is to test the effectiveness of a buoy-based receiving station for monitoring the movements of high-priority avian species (including Federally-endangered roseate terns [Sterna dougallii], Federally-threatened piping plovers [Charadrius melodus], and Federally-threatened red knots [Calidris canutus] in targeted offshore areas along the Atlantic OCS to determine their occurrence, extent,

and flight paths over Federal waters where potential exists for alternative energy development projects.

Methods: FWS will coordinate with the U.S Coast Guard in the Atlantic OCS region to determine the feasibility of installing receiving equipment on existing navigation aids or NOAA data buoys. This is the most cost-effective option for deploying receiving equipment on offshore buoys. Another option is to deploy a dedicated data buoy as a platform for the receiving equipment. This method is more expensive relative to using existing buoys, but offers the most flexibility in regards to specific buoy placement. For either option, the receiving station would consist of four directional, 5-element Yagi antennas. The antennas would be mounted to the top of the buoy tower (approximately 12.5 ft ASL) in a radial configuration to provide 360° orientation. The antennas would connect to an SRX-600 datalogger that is powered by four 45-watt panels wired in series to provide a maximum of 180 watts of power for the receiver. We would visit each buoy-based station approximately monthly to download data and check the equipment, and test the detection range and reception pattern of the station by flying a test transmitter from kite that is towed from the back of a boat at a range of altitudes. The data would be added to the broader detection dataset collected by the region-wide network of radio telemetry stations and used to estimate spatially-explicit movement models of Nanotagged individuals.

Revised Date: January 23, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North and Mid-Atlantic

Administered By: Office of Renewable Energy Programs

Title: Tracking Movements of Threatened Red Knots in the NW Atlantic

BOEM Information Need(s) to be Addressed: Tracking the movements of the recently listed Red Knot is essential for understanding the potential for these species to encounter conflicts with renewable energy development along the Atlantic Coast, for NEPA assessments, and for Section 7 Consultations with the U.S. Fish and Wildlife Service. It will also permit the gathering of information on flight paths and altitudes of these birds at night and during inclement weather conditions, data which has heretofore been unattainable.

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2016-2017

Description:
Background: Since FY2013, BOEM and USFWS have been collaborating on a project that verified digital VHF telemetry ("Nanotags"), a relatively recent technology, for tracking movements of coastal birds. In FY2013 and FY2014, at nesting areas in eastern Nantucket Sound and eastern Long Island Sound, FWS captured and nanotagged 193 common terns (Sterna hirundo), to evaluate this technology on the taxonomically similar but Federally listed roseate tern (Sterna dougallii). To evaluate this technology on shorebirds, a total of 14 American oystercatchers (Haematopus palliatus) were tagged in FY2013, and in FY2014, collaborators tagged over 500 shorebirds of a variety of species (including red knots, as well as semipalmated sandpipers [Calidris pusilla] and black-bellied plovers [Pluvialis squatarola]) at sites throughout the northwest Atlantic.

The movements of tagged birds are tracked using an array of eight (2013) to 16 (2014) automated radio telemetry stations, distributed from Cape Cod, MA, to eastern Long Island Sound, NY, that, to date, have recorded over 8.5 million detections of tagged terns and shorebirds moving throughout the southern New England shelf during their breeding, post-breeding and migratory periods (June–November). In FY2015, tagging efforts are expanding the study to include roseate terns and piping plovers that will be captured at nesting areas in Massachusetts, Rhode Island, and New York, and tracked using an expanded array of 20 automated radio telemetry stations from Cape Cod, MA to western Long Island Sound, NY.

This study will provide new information on the movements and flight altitudes of the Federally-threatened red knot (Calidris canutus) within the Atlantic Outer Continental Shelf (OCS) region. This will allow scientists to assess the degree to which red knots use offshore Federal waters during their staging and migratory periods. Red knots will be captured at major stopover areas in the north and mid-Atlantic during spring and fall migration, and tracked within the U.S. Atlantic portion of their northbound and

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141

southbound flights. As part of this study, existing, 2-dimensional movement modeling techniques will be expanded to include estimates of altitude.

Objectives: The objective of the study is to document movements of Federally-threatened red knots along the Atlantic OCS to determine the occurrence, extent, and altitudes of their flights over Federal waters where potential exists for alternative energy development projects.

Methods: During spring and fall migration, a total of 150 red knots will be captured using cannon nets at stopover areas within Massachusetts, New Jersey, and Virginia. All birds will be tagged using Nanotags. Signals from Nanotags will be picked up from automated receiver towers stationed from Cape Cod, MA to the eastern shore of MD. These receivers will be located so that signals can be received simultaneously from a minimum of two towers, allowing precise 2-dimensional locations of the birds detected. In instances where signals are detected from a minimum of four towers, 3-dimensional locations of birds will be estimated. The data will then be used to construct the pattern of use of offshore waters.

Revised Date: May 13, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid-Atlantic

Administered By: Office of Renewable Energy Programs

Title: Understanding Whale Occurrence, Habitat Use, Density and Abundance in the Wilmington and Kitty Hawk Wind Energy Planning Areas using Passive Acoustic Monitoring

BOEM Information Need(s) to be Addressed: The Federal waters off the coast of North Carolina have been identified for wind energy development in the next several years. However, there are few datasets in this area that provide for a long-term, seasonal understanding of the occurrence of marine mammals in these planning areas. Recent BOEM funded work in the Beaufort wind planning area (lease block NI18-04), and ongoing work in the Georgia and Virginia wind planning areas may help address marine mammal data gaps that exist across North Carolina, but there is still little to no information as to their specific occurrence (and variation) in the Wilmington or Kitty Hawk wind areas. The information will be used to develop appropriate mitigation measures for energy development in these areas.

Approx. Cost: (in thousands) $1,800   **Period of Performance:** FY 2016-2018

Description:
Background: The coastal Mid-Atlantic waters are part of the home range or migratory corridor of several baleen whale species, including the critically endangered North Atlantic right whale. The seasonal usage of this area by different whale species is unclear; existing sources (e.g., OBIS-SEAMAP) suggest that right whale occurrence along the North Carolina coast is limited to nearshore locations in winter months or off the shelf edge.

Results from ongoing passive acoustic monitoring studies at Cornell University have been examining marine mammal occurrence in the mid-Atlantic states (funded in part by BOEM). These data show that many large whale species are occurring throughout the year in coastal areas, which may influence the construction schedule for wind development. For example, in North Carolina, right whales were not confined to nearshore waters, but occurred out to the edge of the outer continental shelf (OCS). Right whales also occurred throughout the year, with peak occurrence in February and March. Other whale species were also acoustically detected (humpbacks and fin whales), but their seasonal occurrence within North Carolina waters was not analyzed. These new data suggest that right and other whale species may be present in these energy exploration and development areas with greater frequency than previous studies indicate, and the current environmental mitigation for energy development may need to be refined to coincide with the actual frequency and duration of protected species occurrence in these areas.

Objectives: The objectives for this study are to:

1) Establish a multi-year record of whale occurrence in the Wilmington (both east and west) and/or Kitty Hawk wind area lease blocks.

2) Determine spatial and temporal patterns of habitat usage of whales in the area.

3) Estimate density and abundance of baleen whales in this area.

4) Collect baseline data on the ambient noise of these areas for evaluating anthropogenic noise levels from either wind turbine construction or site assessment activities.

These study objectives will clarify when marine mammals are occurring in the area, where specifically they are occurring, how much time individuals are spending in the area, their approximate numbers as they are moving through, and what the ambient noise environment is that they are exposed to.

Methods: This study would utilize passive acoustic recording technology to conduct multi-year, year round marine mammal surveys off the coast of North Carolina, from nearshore areas, through the three wind energy planning areas, to the shelf break. From the perspective of seasonal surveys to document year-round occurrence, passive acoustic recording provides a higher detection probability for marine mammals than visual surveys alone. This is particularly during winter months or at night, when aerial surveys are not possible.

We propose to deploy a network of recorders extending to the shelf edge in two configurations. The first would be an east-west linear transect of recorders extending that would be used to detect marine mammals as they are moving through the area. The second would consist of an array of synchronized recorders (distributed in the wind area) and another in the proposed seismic survey lease blocks; these arrays would allow for documenting where in proximity to industry activities individual animals are occurring and their approximate numbers.

Recording devices would collect passive acoustic data continuously for two and half years; and over this period, data would be retrieved approximately every five months for analysis. Acoustic data would be analyzed for the occurrence of selected marine mammal (and potentially fish) species of interest as well as ambient noise levels and sources. Occurrence and location of whale sounds would be accomplished through a combination of automated detection and localization algorithms using Cornell's recently developed High-Performance Computing system, and recently developed species-specific detection methods. All results would be validated by expert human analysts.

Data and results would be summarized in quarterly reports to the agency and other stakeholders, and a final report issued at the completion of the process. Data products will consist of time-series graphs showing occurrence of the focal species, and maps showing their location.

Revised Date: January 15, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North, Mid-, and South Atlantic

Administered By: Office of Renewable Energy Programs

Title: Use of Acoustic and Thermographic Observations to
                         Understand Seasonal and Weather-related Patterns of
                         Marine Birds and Bats

BOEM Information Need(s) to be Addressed: BOEM is considering post-construction monitoring that can address key questions about the interaction between marine birds and wind turbines. Of particular interest are movement patterns at night and during inclement weather. The use of acoustic and thermographic techniques may provide insights into these activities.

Approx. Cost: (in thousands) $2,000   **Period of Performance:** FY 2016-2018

Description:

Background: As construction of the first offshore wind turbines off the coast of the United States nears, the questions being asked about the potential effects are shifting. Careful siting that takes into consideration the distribution of marine birds reduces the risk of birds being killed or displaced by facilities. Now, it is time to prepare for post-construction considerations. Key questions include the behavior of migratory birds at night or in inclement weather.   Acoustic/thermographic devices could monitor vocalizations of birds both day and night at all seasons of the year and in any weather conditions, including periods of low visibility that would prevent effective visual monitoring. BOEM funded the study "*Acoustic Monitoring of Temporal and Spatial Abundance of Birds Near Structures on the OCS of the Atlantic and Gulf of Mexico*" to develop and test the effectiveness of this type of monitoring equipment for offshore use and can be used to estimate bird flight heights - information which is critical to the assessment of risk to birds from wind turbines. If these instruments are used post-construction, they may be used on the service platforms, meteorological towers or wind turbine towers. This technique can monitor birds on the OCS during both daytime and night and in both good and poor visibility conditions, but only at point locations where offshore structures are available. Thermographic and conventional cameras positioned to obtain stereoscopic images will aid in the identification of species and calculation of flight height and vulnerability.

While each of these systems provides data on only a single point in a large ocean, it can provide data continuously all year. Used in conjunction with high-definition aerial surveys, which provide wide area survey data but only on a single day for each flight, the combination would contribute substantially to our understanding of bird and bat use of the OCS. However, further development of the methodologies based on lessons learned is needed. This study will extend the acoustic study to further refine the methodology with the intent to uses the devices post-construction to address key questions.

Objectives: Increase our understanding of the movements of birds around offshore wind structures. This study will produce a year-round record of bird and bat use of the area, including information on flight heights, direction of travel, movement as related to weather and season, and relative abundance of different species, with a focus on federally listed birds and bats. The results of this study will help predict potential impacts from proposed projects and thus help guide permitting.

Methods: The Acoustic and Thermographic Offshore Monitoring (ATOMTM) system gathers data on birds for use in ecological risk assessment, impact assessment, permitting, and monitoring related to offshore energy development. The system was designed specifically to fill data gaps identified by BOEM and the U.S. Fish and Wildlife Service. It is calibrated to automatically detect federally listed species (e.g., Piping Plover) likely to occur in the area. The following equipment sets the ATOM system apart from other existing survey methods:

- Ambient light camera photographs birds and bats flying above the buoy during the day
- Thermographic camera takes images of targets (i.e., birds and bats) both day and night
- Recording equipment records bird and bat sounds
- Automated filters speed data analysis by removing images (such as clouds) and sounds (such as waves) that do not belong to birds or bats

ATOM's ability to identify birds and bats to species is essential for species-specific regulatory drivers such as the Endangered Species Act and the Migratory Bird Treaty Act.

Five ATOM systems will be mounted on five buoys placed 50 to 100 miles apart approximately 2 to 3 miles off the coast between South Carolina and central Florida. Exact locations will be determined through consultation with BOEM and key technical stakeholders. Data will be collected on flight height, direction of travel, movement related to weather and season, and relative abundance of different species. The field unit (hardware) streams data to a computer where species are identified with automated software. Species-specific identification will be possible on a high percentage of species. Nonvocalizing species will be identified using shape and measurements as well as colors and patterns.

The benefits of using the ATOM system for this type of large survey are:

- Lower cost than other survey methods due to fewer staff hours and less travel needed
- Safety (no need to access the area in dangerous field conditions)
- Reliability (not affected by weather conditions)
- Ability to record data under all but the most extreme weather conditions
- Accurate and quality-assured bird and bat counts
- Reduced animal disturbance and/or attraction effects

- Images provide a permanent record and are available to answer future questions
- Images and end product can be quality assured
- Ability to collect a variety of biological information with less chance of human error

If desired, ATOM could be combined with other technologies such as radar.

In addition to producing a final report with results, the data from these surveys will be publically available to answer future research questions regarding bird and bat use in the SA.

Revised Date: May 13, 2015

Reference:

Normandeau Associates, Inc. 2014 Acoustic Monitoring of Temporal and Spatial Abundance of Birds Near Outer Continental Shelf Structures: Synthesis Report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Herndon, VA. BOEM 2014-004. 172 pp.

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Gulf of Mexico OCS/ Atlantic OCS

Administered By: Marine Minerals Program

Title: Discerning Behavioral Patterns of Sea Turtles in the Gulf of
                         Mexico to Inform Management Decisions

BOEM Information Need(s) to be Addressed: Fine-scale information on dive profiles, life history characteristics, and foraging activity is lacking for sea turtles in the Gulf of Mexico. Combining this fine scale movement information with genetic stock analyses, population demographics, health and foraging studies will allow us to address information gaps as identified through the National Environmental Policy Act (NEPA) process and through Endangered Species Act (ESA) Section 7 consultations as required in BOEM's current authorizations. These authorizations require gathering of missing or incomplete data on species to make informed management decisions within BOEM. Results would support data needs related to hazardous spills and decommissioning activities, dredging and trawling associated with coastal restoration programs, and provide knowledge of sea turtle movements and dive behaviors along with their relationships to critical habitats within BOEM Planning Areas.

This study will be conducted in collaboration with US Geological Survey (USGS) to fulfill expertise and permitting needs as they possess the expertise and permits required from NMFS to collect biological samples and tag specimens.

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2016-2021

Description:
Background: Turtles that come ashore to nest, the adult (female) life-stage, is most easily studied but significantly less information is available about habitat use and movements of males, sub-adults and juveniles, which do not come ashore to nest. In a single season, hopper dredge relocation trawling, which is expected to continue over the next several years on GOM restoration projects, captured over 150 ridley young juveniles, sub-adults and adults, loggerhead sub-adults and green young juveniles offering an opportunity to gain much needed knowledge on these life stages.

Opportunistically deploying satellite tags capable of logging dive data along with state-of-the-art acceleration data loggers (ADLs) on turtles captured in association with hopper dredge relocation trawling activities, as required through NMFS consultations to reduce the risk of entrainment of sea turtles, will allow for collection of a robust data sets. These data can provide valuable scientific insight on depth use, movement patterns, mortality risk, utilization of post-dredge sites and dive profiles for all life stages of both sexes. Tags with dive-logging capabilities transmit location information which would provide the data on turtle use of preferred thermal zones of the water column and time spent on the bottom within the vicinity of dredging activities which impacts mortality and entrainment risk. Utilization of data collected on dredge trawlers on which turtles are captured (i.e., by-catch species) can be assessed as a proxy for

available diet information and benthic composition of bottom habitat in habitat modeling efforts.

Objectives: Utilize hopper dredge relocation trawling operations to opportunistically tag sea turtles and collect biological samples to inform management decisions related to trawling and dredge operations. Tracking their movements post-relocation may provide data needed to validate the distance needed for relocation and can also inform other program areas such as decommissioning of oil rigs (by evaluating dive times) and optimization of current sea turtle visual and aerial survey efforts using data gathered on time spent in upper two meters of water column.

The following hypotheses will address the above objectives: 1) Sea turtles will consistently use discrete foraging areas; 2) Sea turtles at foraging areas will originate from multiple nesting groups; 3) Sea turtle distribution will not be uniform; 4) Resource availability will determine presence/absence and distribution of sea turtle species; 5) Sea turtles will display foraging behaviors relative to dredged areas and these foraging behaviors and subsequent entrainment vulnerability will differ between seasons.

Methods: The following field methods are proposed utilizing turtle capture through relocation trawling, when required, for coastal restoration dredging projects off the Louisiana coast;

- Flipper, PIT, and satellite telemetry tags would be deployed on all life stages of individuals to track turtles at foraging grounds to determine site-fidelity, depth use, drivers of local movements and track movements of turtles away from and within sampling/capture sites in the dredged borrow area;
- Accelerometer data loggers (ADLs) deployed using a VHF transmitter and galvanic timer release;
- Biological sampling using skin and carapace biopsies and bilateral cervical sinus blood sampling;
- Gastric lavage to sample gut content for diet, isotopes, and collection of opportunistic by-catch species for foraging analysis;
- Sample all turtles for genetics to determine stock of origin and population connectivity relevant to section 7 consultation needs.

A report will be generated by USGS scientists outlining the findings as well as BOEM management suggestions following the collection, processing, and assessment of data gathered. This turtle detection data and report will provide small and large geographic scale analysis allowing investigation of in-water aggregations of sub-adult, juvenile and adult marine turtles as well as determination of fine scale movement and habitat use within the Northern Gulf of Mexico which will directly inform BOEM on management strategies throughout its programs.

Revised Date: May 4, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Gulf of Mexico OCS / Atlantic OCS

Administered By: Marine Minerals Program

Title: Glider-Based Fish Tracking Along Sand Shoals off Cape Canaveral, Florida

BOEM Information Need(s) to be Addressed: This study proposes to leverage an existing three year collaborative effort between BOEM and the U.S. Navy (Navy), with support from Kennedy Space Center Ecological Program, to investigate the long-term recovery of fish communities following dredging of a borrow area off east-central Florida using autonomous glider-based fish tracking. Monitoring is underway at the Canaveral Shoals complex (including control site shoals) and a significant BOEM investment has already been made. The addition of a wave glider to this monitoring effort could significantly increase the utility of the data obtained from BOEM's acoustic array infrastructure. The existing fixed acoustic array relies on the passage of fishes within a receiver's range of detection (typically 300-1000 meters). The addition of a glider would allow fish relocations to be an active process and increase the number and extent of detections. These detections would add to a long-term dataset tracking recovery and natural movements in offshore habitats. The examination of long-term recovery is necessary for improved regional management of offshore habitat availability for federally managed fish species. Results of this effort would be applicable to the Marine Minerals Program (MMP) as well as the Office of Renewable Energy Programs. These results will improve effects analyses in National Environmental Policy Act (NEPA) documents, and will greatly focus and improve the outcomes of Essential Fish Habitat (EFH) consultations.

Approx. Cost: (in thousands) 600   **Period of Performance:** FY 2016-2017

Description:
Background: Longer term environmental monitoring is important to document disturbances and recovery within sand shoal habitats and the fish communities. These monitoring needs include an improved understanding of: the localized movements of federally managed (EFH) or "keystone" fish species, the degree to which sand shoals serve in the life history of important coastal fishes, and the site fidelity and behavior of small-bodied benthic fish species following dredging events.

Following Hurricane Sandy, the MMP used Disaster Relief Appropriations Act (DRAA) funds to initiate a comprehensive recovery study at Canaveral Shoals, FL. The Navy portion of this partnership commenced in Fall 2013. Though DRAA funds only support three years of data collection, the comprehensive study design, existing project infrastructure (i.e. acoustic arrays, existing tagged fish, developed eco-path models, etc.), and established partnerships (Navy, NASA, BOEM) make it well suited to support long term analysis of recovery and/or resiliency through additional investments. Additional funding would support continued monitoring of tagged fish (1-10 years of remaining battery life) and expansion of our receiving technology through the use of a

wave glider. The receivers at the borrow and control sites have detected many species of fish tagged through these previous efforts (spot, croaker, red drum). However, it has also led to the realization that many of the fish thought to be fairly sedentary make use of a wider home range than previously documented. The use of a glider to expand the acoustic monitoring footprint would enrich this existing data and help provide answers into the natural movement, habitat associations, residency, and recovery for tagged fishes. Additionally, the use of shoal habitat by federally managed species during migrations will be documented.

Other benefits of procurement of the wave glider are the ability to outfit the platform with additional instrumentation to collect habitat information such as water temperature, salinity, turbidity, etc. Additionally, the glider can be deployed at other BOEM borrow areas in the future to collect scientific or animal movement information. Finally, the glider may be shared amongst program areas and utilized to collect data for the Renewable Energy and/or Oil and Gas programs.

Objectives: The objectives of this study are to expand the detection range of the current FACT acoustic array at Cape Canaveral to better resolve fish movements and habitat preferences within the OCS borrow area and associated shoal complexes.
Questions BOEM would like to address include:
- What is the residency of fishes within habitats adjacent to the borrow site?
- Do reestablished sites fill the same trophic function as the original communities?
- What proportion of the shoal complexes (including depth and sediment types) are used by BOEM target species?
- How can we further interpret the data we currently receive from our fixed array with increased detections between receivers?
- Can we validate trends in mobility of fish observed from the fixed array?
- Where else do the target fishes associate in the Cape Canaveral region and OCS? Expanded coverage would enable us to examine fish usage of other adjacent habitat types (reef vs. shoal), other shoal features within the area, and hardbottom habitats further offshore.
- What is the effectiveness of detections from gliders on the periphery of shoal complexes?

Methods: The proposed study sites include existing borrow area and control sites located off Cape Canaveral, Florida. These sites are the location of a portion of the existing FACT array. Ongoing collaboration between the Navy and Kennedy Space Center Ecological Program allows for data sharing, use of the existing 300+ FACT array receivers, and additional information on large-bodied predatory fish (NASA-funded work). In addition, the utilization of a wave glider fitted with a VEMCO Mobile Transceiver would assist the study in meeting the outlined objectives. Observations will be analyzed via basic statistical procedures along with more complex statistical analyses and comparisons of spatial and temporal patterns of movement as well as community structure. All of these data will be further utilized in an ongoing BOEM study that will incorporate the data into Ecopath modeling.

Revised Date: April 30, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Atlantic OCS: Mid Atlantic and South Atlantic

Administered By: Marine Minerals Program

Title: Regional Essential Fish Habitat Geospatial Assessment
and Framework of Offshore Sand Features

BOEM Information Need(s) to be Addressed: This programmatic study proposes to build upon the outcome of the Marine Minerals Program (MMP) Essential Fish Habitat (EFH) Working Group (NT-12-06). Suggestions from the working group included regional EFH planning methodologies. This study will address this need by developing a geospatial analysis framework to develop regional classification of offshore sand features and associated EFH. Historically, EFH Assessments have been developed on a project by project basis using species and biota information specific to a borrow area. These project by project examinations have led to untested mitigation measures and piecemeal environmental assessment. This study seeks to develop a supportive GIS framework that can be used in a classification scheme to predict environmental effects, assess cumulative effects, and design mitigation strategies on a broader landscape scale (for example, impacts to a shoal with respect to all shoals within a geographic area). Defining and organizing spatial relationships of OCS sand bodies along with habitat type will enable BOEM to improve EFH consultations and coordination with other Federal agencies such as the National Marine Fisheries Service (NMFS) and the US Army Corps of Engineers (Corps).

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2016-2017

Description:
Background: The Magnuson-Stevens Fishery Conservation and Management Act requires that any federal agency undertaking or authorizing an action that may adversely affect EFH or federally-managed fish species consult with NMFS. In recent EFH consultations and in the BOEM EFH working group (NT-12-06), NMFS expressed concern about effects to fisheries habitat and federally-managed fishes resulting from project-driven dredging of Outer Continental Shelf (OCS) sand features in the absence of regional habitat management. Various OCS activities, including dredging and wind energy development, may disturb benthic habitat and infaunal/epifaunal communities, such that there are cascading effects on keystone demersal and pelagic fishes (Michel et al., 2013).

Existing bathymetric data and conceptual models can be used to identify and classify geomorphologic features (such as cape-associated shoals, etc.) within regional areas (such as the southeast Atlantic). An on-going MMP study developing a Geospatial Information and Management System will provide a framework for geospatial EFH management. Moreover, sophisticated morphometric analytical tools (that consider sand feature geometry and properties) can be developed to relate geomorphology to diversity/uniqueness of habitat types. The geomorphic form and distribution of seafloor sand bodies and the distribution of benthic organisms and assemblages are influenced

by a number of physical processes; therefore, an examination of available current, wave, storm and other oceanographic and meteorological observational data is important to identify ecosystem response to these controls. Once the features are identified, existing information on biological attributes such as EFH and associated biota can be overlain geospatially. BOEM has information on faunal distribution and how it varies with geography (e.g., latitude), geomorphology, and bathymetry (Theroux and Wigley 1998, Brooks, et al. 2006). Utilizing this GIS database, a comparison can be made of the habitat type (geology and physical/chemical processes), localized EFH, and biota of the borrow area to these same attributes within the broader region (such as southeast Atlantic) to identify appropriate mitigation and minimization measures (based on uniqueness, species diversity, etc. of the feature).

The development of a programmatic framework is critical to BOEM's MMP, Office of Renewable Energy (OREP), and numerous federal and state agencies to evaluate and plan for the use of offshore features. Currently, this information is assimilated without the use of regional environmental planning. This programmatic geospatial framework would be employed to identify and integrate offshore morphological features, to facilitate environmental analyses and track these biophysical parameters on a regional scale through time.

<u>Objectives</u>: The purpose of the study is to develop a GIS-based framework that helps to define and employs spatial relationships between EFH and marine geomorphology. Questions to be answered include:
1. What is the level of diversity/uniqueness of varied geomorphic habitats along the Mid- and South Atlantic Coasts?
2. How do the NMFS-established EFH designations overlap with bathymetric/geomorphic classification data?
3. How can we incorporate information about the biota associated with known habitat types (diversity, recovery, geomorphology) and the EFH designations to improve recovery and minimization efforts?
4. How can we tie in physical processes such as currents and waves to management and recovery of sand shoal habitats?
5. What are data gaps associated with linking geomorphic form and biological associations that we need to pursue in future studies?

<u>Methods</u>: To reach this objective this study has five main facets:
1. Develop a regional, high-resolution bathymetric model utilizing most recent data.
2. Classification of the various geomorphic features (e.g. developing a geomorphic classification scheme, conducting a morphometric analysis).
3. Identify regional physical process regimes controlling geomorphology, habitat utilization, and frequency of disturbance
4. Complete a literature analysis to identify biological use of the various geomorphic features.
5. Develop a habitat use assessment framework that will then be utilized to identify attributes/parameters specific to sand features and a sub-region classification scheme to inform regional-scale environmental impacts analyses.

Revised Date: April 30, 2015

References:

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Theroux, R. B., and R. L. Wigley. *Quantitative composition and distribution of the macrobenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States.* U.S. Dept. Commerce, NOAA, 1998, 240.

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Gulf of Mexico OCS / Atlantic OCS

Administered By: Marine Minerals Program

Title: Evaluating Increased Habitat Value and Function in OCS
                          Sand Resource Areas Following Dredging Events

BOEM Information Need(s) to be Addressed: The Marine Minerals Program (MMP) provides valuable opportunities in collaboration with local, state, and federal partners to provide critical sand resource needs to support coastal resiliency initiatives along the Atlantic and Gulf coasts of the United States. A significant literature base exists that evaluates site specific resource impacts associated with the excavation of sand from OCS sediment resource areas (i.e. borrow areas) using hydraulic dredging methodologies. However, studies evaluating the efficacy of site specific sand excavation techniques to increase habitat value and function are limited. This information is vital in the development and management of Outer Continental Shelf (OCS) mineral resources, particularly in regards to National Environmental Policy Act (NEPA) and Essential Fish Habitat assessments, to fully understand the impacts, both positive and negative, of BOEM's actions and avoiding or minimizing adverse impacts to the environment. Evaluating the potential benefits of current or modified borrow area design and excavation methodologies to improve or enhance natural sand resource features supports BOEM's adaptive management and environmental stewardship responsibilities.

Approx. Cost: (in thousands) $200   **Period of Performance:** FY 2016-2017

Description:
Background: Dredging is an impact producing factor in projects that require offshore sand resources to support coastal resiliency initiatives for improved coastal habitat function and protection of valued resources. Analysis of time-series habitat-relevant data on dredging projects has indicated that engineering post-dredging geomorphic features in borrow area excavation designs may promote enhanced biological assemblages relative to the pre-dredge conditions. An extensive literature base of post dredging borrow area monitoring exists, including multiple BOEM investments, documenting the effects and recovery rates of benthic macro-invertebrates communities, biological and biophysical impacts, and habitat associations and long term effects of dredging on fisheries (BOEM/Navy IA, Ongoing Study, Michel et al. 2013). Studies suggest that most borrow areas show significant recovery within 1 to 2 years after dredging (Byrnes et al., 2003; Jutte et al., 2002; Blake et al., 1996; Van Dolah et al. 1992) and 5-10 years for recovery of complex biological associations (Newell et al. 1998). However, these studies predominantly focus on the negative effects of dredging activities on resources directly impacted by the extraction of the benthic sediment resource and document opportunities for how to avoid and/or minimize these effects to promote quicker recovery of the benthic resource. Little consideration is given to the potential positive effects of post dredging environments within the context of increased habitat diversity relative to the larger surrounding environment. International

studies, as well as research on fish assemblages, have suggested that modification to the seafloor potentially adapts the environment in such a way that recovery is faster or, in some cases, recovers beyond the original conditions thereby "improving" the environment. Dredged sites may be sustainable opportunities to increase value of the seabed but have yet to be fully investigated.

Findings from this study would complement proposed borrow area optimization studies on the FY 15 National Studies List and development of substrate and geoform classification standards. Potential cooperative support is available by the USACE Engineering Research and Development Center (ERDC).

Objectives: This study aims to document methodologies to improve the ecological conditions at dredge extraction sites based on an analysis of existing data. Specifically, the study objective will be to identify opportunities for improving post-dredging habitat function and value using existing and/or new excavation techniques while considering dredging feasibility and cost constraints. Prior to any study proposals field testing theories, the study will recommend hypotheses that test maximization of post dredging habitat value.

Methods: The study entails an analysis of existing literature and data currently available to document specific factors which support high valued offshore fisheries habit within varying offshore sand resource areas. To achieve the study objectives, this report will:

- Identify and collect current available data pertaining to existing and new dredge design templates and methodologies;

- Provide ecological and cost implications of the identified design templates;

- Analyze the positive effects and habitat function of the identified borrow designs using available data

- Determine the environmental conditions required to successfully achieve positive effects;

- Develop proposed management strategies relevant to the MMP which would further enhance or improve habitat conditions at mining sites in the OCS.

Supporting data will be gathered from current BOEM documents such as the RPI 2013 report and on-going research on long term ecological recovery in dredged undisturbed furrows. In addition, any other means necessary to identify, acquire, review, and annotate all scientific and technological literature will be used to support the investigation and analysis.

Revised Date: May 7, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Aerial Surveys of Arctic Marine Mammals (ASAMM) –
                            Personnel and Aircraft Needs

BOEM Information Need(s) to be Addressed: This study will maintain long-term
monitoring information about potential impacts to marine mammals from offshore
exploratory oil and gas activities and subsequent leasing in the Chukchi and Beaufort
Seas. The information will assist BOEM in NEPA analyses, ESA Section 7 consultations,
MMPA documentation for Lease Sales, EPs and DPPs, and ongoing decision-making in
the Beaufort and Chukchi seas.

Approx. Cost: (in thousands) $12,800   **Period of Performance:** FY 2016-2019

Description:
Background: Bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius
robustus*), beluga whales (*Delphinapterus leucas*), Pacific walrus (*Odobenus rosmarus
divergens*), polar bears (*Ursus maritimus*), bearded seals (*Phoca fasciata*), and several
other species of ice seals are known to occupy the Chukchi Sea, at least during some
seasons. All of these species are subject to changes in environmental variables such as
oceanographic currents, sea temperature, sea ice cover, prey availability, and
anthropogenic impacts. Moreover all of these species are used for subsistence both in
Russia and the US and form an important part of the diet and cultural base for most
people in villages along the Chukchi coast. Having a good understanding of the seasonal
distribution, relative abundance, and habitat use of marine mammals in the Chukchi
Sea is fundamentally important to evaluating the potential environmental impacts
associated with oil and gas exploration and development and other anthropogenic
activities. Reliable, up-to-date information of this type is needed for marine mammal
populations in the Chukchi Sea. Aerial surveys of marine mammals are an efficient tool
because they offer quick coverage of large marine areas. Past surveys are available for
comparison with new data to assess whether changes in distribution or abundance have
occurred since the earlier surveys were completed.

A BOEM-funded investigation of the seasonal migration of the bowhead whales using
satellite-tracked animal tags revealed that they are resident in the Bering Sea during the
winter and return to the Beaufort Sea in the summer when opening spring leads allow
for passage along the Alaskan and Canadian coasts. The bowheads leave the Beaufort in
the fall and cross the Chukchi Sea before moving back into the Bering Sea for the winter.

Since 1979, aerial surveying of the fall migration of the bowheads has been conducted,
initially by the Bureau of Land Management and subsequently by MMS, now BOEM.
This is one of the longest-maintained monitoring of a biological phenomenon and has
produced an invaluable baseline of the distribution and habitat use of the bowheads.
The baseline can be used to observe changes in distribution and habitat use that may

occur due to changing atmospheric and oceanic climates and to offshore oil and gas development activities. This investigation will continue the aerial observations of the fall migration for evidence of these changes. Since the beluga whales and other marine mammals seasonally or otherwise resident in the Beaufort and Chukchi are often sighted during the bowhead whale aerial surveys, their occurrence will also be part of the acquired data.

<u>Objectives</u>:

Document the distributions and relative densities of marine mammals in the Chukchi Sea and Beaufort Seas Planning Areas.

To the extent possible, delineate the areas that are most important to marine mammals during critical seasons of their annual life history cycles such as calving and feeding.

Define the annual fall migration of bowhead whales, significant inter-year differences, and long-term trends in the distances from shore and water depths at which whales migrate.

Monitor temporal and spatial trends in the distribution, relative abundance, habitat, and behaviors (especially feeding) of whales in arctic waters.

Provide real-time data to BOEM and NMFS on the general progress of the fall migration of bowhead whales across the Alaskan Beaufort and Chukchi Seas for use in protection of this Endangered Species, if needed.

Provide an objective wide-area context for management understanding of the overall fall migration of bowhead whales and site-specific study results.

Document the spatial and temporal distribution of beluga and gray whales, and other marine mammal species as sighted.

<u>Methods</u>: This Interagency Agreement between NMFS and BOEM will fly aerial line-transect surveys in the Chukchi Sea and Beaufort Sea Planning Areas from mid-July to the end of October to observe the fall migration of the bowhead whales, continuing the decades-long set of observations. For surveys in both seas, the observational and data recording methodology shall follow protocols used by the BOEM in the past surveys of the bowhead fall migration. The scientists will be responsible for the management of this project, all necessary training of support personnel, providing all needed field equipment, conducting all logistical tasks, acquiring all necessary permits, and insuring the safety of all people involved.

The necessary aircraft services (planes, fuel, maintenance, pilots, etc.) to pursue the science objectives will be supported via Interagency Agreement between the National Business Center's Office of Aviation Services and BOEM.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Collaboration with North Pacific Research Board (NPRB)
Arctic Marine Research Program

BOEM Information Need(s) to be Addressed: BOEM needs to leverage funding for updated environmental data collection as significant opportunities arise. The National Science Foundation and the North Pacific Research Board have worked together programmatically and scientifically through the Bering Sea Project since 2007 (http://bsierp.nprb.org). Based on this successful collaboration, BOEM and NPRB plan to partner on new collaborative research in the Arctic, leveraging expertise across several partners and funding sources, including BOEM, NSF, NPRB, NOAA, Alaska Ocean Observing System (AOOS), USGS, ONR, NASA, North Slope Borough, Northwest Arctic Borough, industry and others, specifically in the Chukchi and Beaufort seas. Research from this collaboration will support mutually identified information needs on the physical, biological and social processes in the Arctic marine environment.

Approx. Cost: (in thousands) $1,000   **Period of Performance:** FY 2016-2021

Description:
Background: The Alaska OCS Region has a long history of supporting multidisciplinary research, beginning with the *Outer Continental Shelf Environmental Assessment Program* (OCSEAP) surveys conducted between the 1970s and early 1990s and the *Beaufort Sea Monitoring Program* in the 1980s. The *Arctic Nearshore Impact Monitoring in Development Area* (ANIMIDA) program and its continuation (cANIMIDA) started in 1999 to provide baseline data and monitoring results for chemical contamination, turbidity, and subsistence whaling in the vicinity of Northstar and Liberty development sites. This work continues today with the studies *ANIMIDA III: Boulder Patch and Other Kelp Communities in the Development Area*, begun in 2012, and the recently awarded *ANIMIDA III: Contaminants, Sources, and Bioaccumulation*, which has been expanded to include Camden Bay.

Since 2007, the Alaska OCS Region has also developed a new suite of studies in the Chukchi Sea, leveraging more than $70 million (through FY 2015) to conduct interim baseline research and monitoring in all the following fields of interest: meteorology, ice dynamics and basic oceanography, benthic fauna and sedimentation, marine mammals (including whales, walrus, seals, and polar bear), fish, birds, and social systems. Most of the projects exhibit complex, multilateral collaborations, with explicit inter-disciplinary linkages between the physical and biological sciences, and many of them also provide a role for active participation by Alaska Native residents and input from sources of traditional knowledge. Most of them pursue multi-year data collection efforts on a regional scale, with careful attention to inter-annual variability and ecosystem processes. The newly funded *Arctic Marine Biodiversity Observation Network* (AMBON) in the Chukchi Sea is a prime example.

<u>Objectives</u>: BOEM seeks to build upon existing working relationships with NPRB, NOAA, USGS, AOOS, industry and others by establishing financial cooperation, coordinated Request for Proposals, data sharing agreements, and logistical support agreements. The foundation for such partnerships will be based on BOEMs Annual Studies Planning Process.

<u>Methods</u>: BOEM, NPRB and other funding partners will build upon newly available synthesis projects (such as Synthesis of Arctic Research [SOAR] and the Pacific Marine Arctic Regional Synthesis [PacMARS] to examine areas where collaborative studies could help enhance informed decision-making on the sustainable use of resources. This collaborative study will be guided by an oversight committee formed of senior scientists and accomplished through an annual request for proposals (RFP). Recommendations for select studies would be based on program development goals. After BOEM review of RFP responses, subgroups of interdisciplinary scientists will work together with NPRB to select specific task orders for BOEM funding. Targeted areas for new research in the Chukchi Sea would include, but are not limited to: influence of sea ice dynamics and advection on the phenology, magnitude and location of primary and secondary production; distribution and life history of upper trophic predators in response to availability of lower trophic prey resources; and improving knowledge about rates of consumption, growth, and reproduction of benthic and pelagic organisms. Deliverables from this study will include final reports, published papers, and synthesis workshops to integrate multi-disciplinary datasets that will include participation of several BOEM-funded PIs.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Community Web Access to WRF Atmospheric Model
Results and Meteorological Station Data, 1979-2009

BOEM Information Need(s) to be Addressed: This project will assist BOEM in meeting new "Open Data policy" requirements so that significant data products produced from BOEM-funded efforts are made available for further use by broader scientific research communities and the general public.

Approx. Cost: (in thousands) $40   **Period of Performance:** FY 2016

Description:
Background: BOEM recently completed a study called *Beaufort and Chukchi Seas Mesoscale Meteorology Modeling* (OCS Study BOEM 2012-0119). The major study product was the Chukchi–Beaufort High-Resolution Atmospheric Reanalysis (CBHAR) using the Weather Research and Forecasting (WRF) model. The CBHAR produced near surface, high resolution (10 Km) atmospheric model output for the Beaufort and Chukchi seas Outer Continental Shelf (OCS), including the offshore and onshore areas of Russia, Alaska, and Canada. The CBHAR spanned the years between 1979-2009. Another study product was a complimentary set of observational data comprised of over 260 meteorological stations, covering the CBHAR spatial and temporal model domain. The large volume of data is currently inaccessible to the broader scientific community because of processing costs. Funds are needed to archive, display, and serve the model output and observational data as an accessible data product. The Alaska Ocean Observing System (AOOS) data management team will load the CBHAR and corresponding observational archive into the AOOS data system for long term storage and for serving out to the broader user base. Both the model and observational data will be made available for visualization, analysis and access through several existing tools already available at AOOS.

Objectives: The objective of this project is to make the CBHAR and the meteorological observational data compilation available for open use by scientific research communities and the general public.

Methods: The data team will review the CBHAR to document the climate and forecast (CF) metadata conventions. The data will be processed, uploaded to the AOOS online data portal and linked to available visualization and analysis tools. The meteorological observational archive will be migrated from existing formats to CF compliant NetCDF (network Common Data Form) files for posting on the AOOS data portal. Query tools will provide the user with the capability to extract subsets of the model and observational data for external use.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Updates to the Fault Tree for Oil-Spill Occurrence
Estimators

BOEM Information Need(s) to be Addressed: The Oil-Spill-Risk Analysis
(OSRA) is a cornerstone to regional EISs, EAs, and oil-spill contingency planning.   Oil-
spill issues constitute a significant portion of public comments submitted on sale or
development EISs in the Alaska OCS Region. This study is necessary to incorporate
fault-tree spill occurrence estimators into NEPA analyses for Arctic oil and gas lease
sales or Arctic development in the expected 2017-2022 time period, concurrent with the
next BOEM 5-Year Program.

Approx. Cost: (in thousands) $100   **Period of Performance:** FY 2016-2021

Description:
Background: The OCS spill occurrence rates used in non-Arctic BOEM NEPA analyses
are based on historical platform, pipeline or tanker crude oil-spill rates, almost entirely
from the Gulf of Mexico and Pacific OCS. Since 2002, the BOEM Alaska OCS Region
has incorporated a fault-tree approach which considers 1) differences in oil-spill
occurrence factors between the Arctic and Gulf of Mexico OCS and 2) Arctic-specific
factors. Recent examples of such analyses include:

Bercha Group, Inc. 2014. Updates to Fault Tree Methodology and Technology for Risk
Analysis Chukchi Sea Sale 193 Leased Area. OCS Study BOEM 2014 -774.
Anchorage, AK: USDOI, BOEM, Alaska OCS Region. 109 pp.

Bercha Group Inc. 2013. Updates to Fault Tree for Oil Spill Occurrence Estimators,
Update of GOM and PAC OCS Statistics to 2012. OCS Study BOEM 2013-0116.
Anchorage, AK: Prepared by Bercha International Inc. for USDOI, BOEM, Alaska
OCS Region. 35 pp. http://www.boem.gov/2013-0116/.

Bercha, F.G. 2011. Summary Final Report Alternative Oil Spill Occurrence Estimators
for the Beaufort and Chukchi Seas - Fault Tree Method. OCS Study BOEMRE
2011-030. Anchorage, AK: Prepared by Bercha Group, Calgary, Alberta, for
USDOI, BOEMRE, Alaska OCS Region. 48 pp. http://www.boem.gov/BOEM-
Newsroom/Library/Publications/2011/2011-030.aspx.

Objectives:

Update Gulf of Mexico and Pacific OCS historical oil spill statistics.

Obtain updated fault tree spill occurrence rates and confidence intervals for NEPA
analyses for any Arctic OCS Lease Sales or for OCS offshore oil and gas
developments during the contract period of performance.

<u>Methods</u>: This study will: 1) review and assimilate oil-spill occurrence reports, data and geohazard data from alternative sources and locations as needed to update Gulf of Mexico and Pacific OCS historical data; 2) use these data together with measures of spill size and frequency variance to run the Monte Carlo fault tree model with these measures of variance; 3) provide updated fault tree analyses for Arctic oil and gas lease sales based on BOEM-supplied exploration and development scenarios, generating life-of-field oil spill occurrence rates and indicators; 4) provide additional fault-tree analyses as needed for Beaufort and/or Chukchi Seas for site-specific oil and gas developments, taking into account site-specific geohazards and generating life-of-field occurrence indicators; 5) provide a formal report documenting each analytical or fault-tree update, and 6) provide professional support to BOEM in regard to statistical issues of occurrence rates and estimator(s) related to this study and its results.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea, Cook Inlet

Administered By: Alaska OCS Region

Title: Community Based Monitoring: LEO Network

BOEM Information Need(s) to be Addressed: BOEM needs information on a variety of environmental variables to effectively conduct environmental analyses against a backdrop of changing environmental conditions. The Arctic is undergoing climate change affecting subsistence harvests on the land and at sea. Frontline observations are made by residents of rural communities including Alaska Native subsistence harvesters, who can readily identify abnormalities in local habitat, prey availability, species composition, and seasonal timing of ecological processes. In an effort to capture and document such observational data, the Alaska Native Tribal Health Consortium (ANTHC) Center for Climate and Health has developed the Local Environmental Observer (LEO) Network. Now the program has come to a programmatic crossroads and requires new funding support. BOEM intends to collaborate on this established observation network and enhance its utility for scientific decision-making. The data will be used to support NEPA analyses both to document changing environmental conditions and to assess the range of implications for human communities.

Approx. Cost: (in thousands) $400   **Period of Performance:** FY 2016-2020

Description:
Background: LEO is the acronym for the Local Environmental Observer Network, a volunteer program of mostly tribal environmental professionals who share information about environmental events where they live, post observations on public Google maps, and coordinate with technical experts to identify appropriate actions. The purpose is to increase understanding about climate change and other drivers of environmental conditions to facilitate development of appropriate adaptation strategies. To achieve this, LEO strives to integrate science, traditional knowledge, and modern technology to achieve a robust and effective observation system.

Members self-enroll via the LEO Network website. Since the program was initiated in January 2012, over 250 individuals in 120 communities have enrolled across Alaska and in western Canada. They receive training on how to be effective observers and use of the tools available through the LEO Network. Posted observations are reviewed in monthly webinars and annual conferences. Updates on new LEO posts are communicated through social media and a weekly e-news that is distributed to network members as well as a list-serve of over 1500 subscribers nationally and around the circumpolar north. Dozens of state, tribal and federal agencies and academic institutions provide technical consultation support to LEO based on their topical expertise. Most of these communities are coastal, but there is growing participation in interior Alaska as well. The Network maintains a database of community based observations on a wide range of topics including extreme weather, floods, erosion, ice changes, permafrost thaw,

invasive species, infrastructure damage, environmental contamination, and changes in the health, range, and behavior of fish, insects, birds and wildlife.

LEO was originally developed by the ANTHC Center for Climate and Health, with supplemental funding from the Environmental Protection Agency and the Western Alaska Landscape Conservation Cooperative, a partnership of federal agencies addressing climate change impacts on the nation's landscapes. ANTHC serves as the hub for the LEO Network.

Objectives: This study would identify and promote pathways for incorporating observations and real time documentation in the coastal northern and Cook Inlet regions for the following variables:

Sea ice formation, significant ice events, and transitions to open water;

Subsistence activities in the marine environment for sea mammals, fishes, and birds, and observations regarding variations attributable to changing environmental conditions;

Loss of permafrost and its effects on habitat, health, behavior, and infrastructure;

Coastal erosion and its effects on habitat, health, cultural resources, and infrastructure;

Changes in migratory patterns and its effects on abundance, phenology, etc.

Changes in habitat range that may be indicative of regime shifts.

Further institutional objectives include:

Increase understanding about environmental change;

Enhance tools available at the community and regional level to assess impacts;

Improve communication and collaboration among communities, state and federal government, and other institutions;

Facilitate development of healthy and effective adaptation strategies.

Document community-based valuations of environmental resources.

Methods: The following processes are maintained by LEO Network managers in order to sustain the program systems: enrollment and training of new members; management of observation posts and consultations; transfer of observation content to data systems; connecting observers with technical experts in partner organizations; publishing new observations on Google maps; outreach on observations to the Network, social media, and the website; weekly publication of Climate and Health E-News; planning and hosting monthly webinars and annual conferences; synthesize data for education, policy development and management decision through the Alaska One Health Working Group.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Region:　　　　　　　Alaska

Planning Area(s):　　Chukchi Sea

Title:　　　　　　　Estimation of Abundance and Demographic Rates of
　　　　　　　　　　　Pacific Walruses Using a Genetics-based Mark-Recapture
　　　　　　　　　　　Approach

BOEM Information Need(s) to be Addressed: Large numbers of Pacific walruses (*Odobenus rosmarus divergens)* utilize areas of high oil and gas resource potential in OCS waters of the northeast Chukchi Sea. BOEM needs reliable estimates of abundance and demographic rates of Pacific walruses for use in sound planning, management, and mitigation of potential environmental impacts from oil and gas activities and climate change. Abundance and demographic rates of walruses are also important for NEPA analyses, stock assessments under the Marine Mammal Protection Act (MMPA) and for extinction risk assessment under the Endangered Species Act (ESA). Results from this study will be used for future Chukchi Sea lease sales as well as in post-sale and post-exploration BOEM decision making and mitigation.

Approx. Cost: (in thousands) $150　　　　**Period of Performance:** FY 2016-2019

Description:
Background: Walruses are a protected species under the MMPA and are listed as warranted but precluded under the ESA. As part of a 2011 Multi-District Settlement Agreement (United States District Court Docket No. 2165), the U.S. Fish and Wildlife Service must make a decision by September 2017 on whether to propose the walrus for listing under the Endangered Species Act or remove it as a candidate species. Information on abundance and demographic rates will be an important contribution to the relisting decision, which will impact how BOEM manages overlap between oil and gas exploration and development and walrus activity.

Furthermore, oil and gas activities in the OCS areas of the Chukchi Sea have increased dramatically in the last 5 years and this trend is expected to continue. Permitting of these activities relies on a small numbers determination and combining estimates of regional abundance. Current BOEM-funded walrus studies examine distribution and habitat patterns in the Chukchi Sea, as outlined in the studies *Walrus Seasonal Distribution and Habitat Use in the Eastern Chukchi Sea* (AK-13-06), and *Walrus Habitat Use in Drilling Area* (AK-09-01). The results from these studies, combined with a better population estimate of Pacific walrus, would allow managers at BOEM and U.S. Fish and Wildlife Service (USFWS) to determine the proportion of the population that could potentially interact with these activities. Therefore, comprehensive estimates of global abundance and demographic rates for walruses are important for regulatory and mitigation activities associated with oil and gas development in the northeast Chukchi Sea.

Past efforts to estimate abundance of walruses were based on aerial surveys. The study *Development of Airborne Remote Sensing Methods for Surveys of Pacific Walrus* (OCS Study MMS 2006-003) identified a number of drawbacks to the use of this technique for measuring abundance with sufficient precision to monitor population trends. Therefore, the USFWS, in collaboration with the Alaska Department of Fish and Game, ChukotTINRO, the Association of Traditional Marine Mammal Hunters of Chukotka, and the Eskimo Walrus Commission, secured funds to initiate a genetics-based mark-recapture project for estimation of abundance and demographic rates of walruses in FY 2013.

Objectives: The objective of this study is to partner with USFWS to support the laboratory testing component of a project that uses a genetics-based mark-recapture approach to achieve the following goals:

Estimate annual abundance of walruses for evaluation of population status and trends by applying mark-recapture analytical techniques to biopsy samples.

Assess demographic rates of walruses including age and sex specific survival and fecundity for validation and parameterization of population models.

Compare the estimates of abundance produced from this study with those produced from the BOEM study *Walrus Seasonal Distribution and Habitat Use in the Eastern Chukchi Sea* (AK-13-06) that estimates the abundance of walruses in the OCS areas of the northeast Chukchi Sea for assessment of the proportion of the population potentially exposed to oil and gas activities in the region.

Methods: Genetics testing will be conducted on up to 2000 walrus biopsy samples per year (different age/sex classes). In addition to existing samples, skin biopsy samples will be collected from live walruses hauled out on sea ice during their northward migration from 2016 through 2018. Researchers will utilize the expertise of subsistence hunting communities in both the U.S. and Russia for sample collection. Individual walruses will be identified using single-nucleotide polymorphism markers which are currently being developed by the USFWS. Mark-recapture models will use the resultant genetic information to estimate abundance. Interim results will be made available to the USFWS to help inform decisions regarding listing of walrus. Results of mark-recapture analyses will be used to estimate population size, population growth rate, age and sex specific survival rates, and recruitment of walruses starting in 2016 and continuing through 2018.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Development of an Arctic Trajectory Analysis Planner (TAP)

BOEM Information Need(s) to be Addressed: A stochastic trajectory analysis tool is needed to facilitate evaluation by BOEM analysts of the threat to a particular site or resource from a potential oil spill within the Pacific Arctic region. The results of this study will be used by BOEM to supplement oil-spill risk analysis for impact assessment needed for EISs, EPs, and DPPs within the Beaufort Sea and Chukchi Sea planning areas. The results may also be used for preparing oil spill response plans.

Approx. Cost: (in thousands) $200   **Period of Performance:** FY 2016-2019

Description:
Background: The Trajectory Analysis Planner (TAP) is a computer-based tool developed by NOAA's Office of Response and Restoration that investigates the probabilities that spilled oil will move and spread in particular ways within a particular area. The TAP is a planning tool that can be used to estimate the probability of where spilled oil will go by assessing hundreds of site-specific oil-spill trajectories. Based on location and other details of a hypothetical spill, the TAP provides information and graphical analysis regarding what areas could be affected and how environmental resources might be contacted. Conversely, the TAP can also provide information about where might a spill occur that could threaten a particular location of concern. Currently, the TAP does not include sea ice in the calculations, limiting its utility in the Arctic.

The visualization tools within the TAP would be very helpful for improving understanding of BOEM's oil spill risk analysis by stakeholders and the public.

Objectives:

   Identify an up-to-date and comprehensive list of environmental resource areas in the Beaufort and Chukchi seas for inclusion in the TAP.

   Develop a TAP for the Pacific Arctic north of Bering Strait.

Methods: This project will identify appropriate inputs from model components for use in an Arctic TAP based on input from Federal and State agencies and other stakeholders, including results from recent research projects such as the Alaska ShoreZone Coastal Mapping and Imagery project. The NOAA Office of Response and Restoration will modify the existing TAP software tool to incorporate sea ice and offshore resources, and will make the Arctic TAP available on their website to all Federal and State agencies, non-governmental organizations, and local stakeholders.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Synthesis and Evaluation of Sub-Seabed Physical
                                   Environmental Data for the Beaufort and Chukchi Seas

BOEM Information Need(s) to be Addressed: BOEM needs an updated database and derived analytic products to improve regional assessments of subsea geology and shallow hazards and to refine the characterization of those areas that may contain paleo-archaeological resource potential within the Beaufort and Chukchi Outer Continental Shelf (OCS). This study will improve regional understanding of current geological processes (sedimentation, benthic habitats, ice gouging, strudel scour, faulting, shallow gas, etc.), soil engineering properties, permafrost and methane hydrate distribution and oil seeps. This effort will also assist with the preservation of potential archeological resources, including shipwrecks and the late Cenozoic geologic history of the Beaufort and Chukchi shelf areas, as mandated the National Historic Preservation Act (NHPA). The study will be used for a variety of pending National Environmental Policy Act (NEPA) assessments, including area Lease Sale Environmental Impact Statements (EISs), Exploration Plan Environmental Assessments (EAs), and Development and Production Plan EISs.

Approx. Cost: (in thousands) $750   **Period of Performance:** FY 2016-2018

Description:
Background: Shallow, high-resolution geological and geophysical (G&G) data, including core logs, are collected as Ancillary Activities by the oil and gas industry on the shelves of the Beaufort and Chukchi seas. These data are used to define the surface and shallow geology and to analyze potential hazards that may be associated with the area surrounding planned exploration or development drill sites and proposed pipeline routes. These data have been used by BOEM to map and understand current geological processes and assess archeological resource potential for NHPA responsibilities. The information and data from these site-specific and pipeline surveys from the Beaufort Sea collected during the 1980s and 1990s were integrated into a relational database as part of the study *Evaluation of Sub-Sea Physical Environmental Data for the Beaufort Sea Alaska OCS and Incorporation into a Geographic Information System (GIS) Database* (OCS Study MMS 2002-017). This database does not include any data and supporting information from surveys conducted in the Chukchi Sea OCS, nor does it include updates of more recently collected information from site-specific surveys in the Beaufort Sea since the last study was published in 2002. The more recent information from ancillary activities is important for evaluating new Exploration and Production Plans (EPPs) proposed for the Beaufort and Chukchi Sea OCS.

Objectives: This study will integrate surface and shallow G&G data in the Beaufort and Chukchi Sea OCS regions from multiple site-specific shallow hazard surveys, pipeline surveys, and other available oceanographic, biological and geological studies into an

updated GIS relational database, building from OCS Study MMS 2002-017.   The data are crucial in the preparation of pending NEPA assessments, Environmental Assessments, and Environmental Impact Statements. Specific objectives include the following:

Provide regional contexts for the technical review and evaluation of geologic hazards, engineering issues, and potential cultural resources in the EPs and DPPs submitted by industry.

Evaluate regional characteristics of the geology, history, dynamic processes, and benthic substrate in areas of the Chukchi and Beaufort seas where drilling sites and pipeline routes may be located.

Refine the identification of lease blocks that will require archaeology survey mitigation or conservation of essential habitat.

Methods: This study will inventory all site-specific survey reports, pipeline survey reports, BOEM studies, and data that could be used to build the discussed integrated database. A comprehensive bibliography from all relevant collected site-surveys and completed studies will be produced. Researchers will locate and assemble previously collected G&G datasets with analysis of core logs into a single geospatial format compatible with the latest versions of ArcGIS. Interpreted data from the reports and completed BOEM studies will also be incorporated. Products from the study will include a synthesis report of the collected data and the methods used to analyze the data based upon documentation from the individual site-survey reports, and updated ArcGIS user interface to allow the user to easily query and display data from geographic locations within the Chukchi and Beaufort OCS.

Revised Date: June 8, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Cook Inlet

Administered By: Alaska OCS Region

Title: Updating Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet

BOEM Information Need(s) to be Addressed: Monitoring of seabird populations and forage fish stocks in potential oil and gas lease areas has been a BOEM priority for decades, both to mitigate impacts of development and to assess the effects of potential oil spills. However, both tasks are compromised when population estimates are outdated, and prediction of resilience to development or spills is enhanced by knowledge of population dynamics and current trends. Following intensive investigations of seabirds and forage fish in lower Cook Inlet during 1995-2000, collection of such data in lower Cook Inlet has been limited. The information collected in this partnership with USGS will be used to support environmental analysis for an upcoming lease sale in Cook Inlet and other associated activities in 2017 and beyond.

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2016-2018

Description:
Background: Seabird densities in lower Cook Inlet are among the highest in Alaska—one reason why the greatest damage to marine bird populations from the Exxon Valdez oil spill occurred there. Resident and migratory seabirds are supported by abundant local stocks of key forage fish species such as herring, sand lance and juvenile pollock. USGS led seabird and forage fish studies in lower Cook Inlet during 1995-1999 to assess the recovery of seabird populations following the 1989 *Exxon Valdez* oil spill. Results of this work have been reported in 45 publications and 8 final reports. The original project was designed to measure the foraging and population responses of six seabird species to fluctuating forage fish densities around three seabird colonies in lower Cook Inlet (Barren, Chisik and Gull islands). These studies included at-sea surveys for forage fish (hydroacoustics, trawling, seining and associated oceanographic measurements) while measuring aspects of seabird breeding biology (egg and chick production, chick growth, population status and trends) and foraging behavior (diets, feeding rates, foraging time) at the three colonies. The most detailed data were collected on Common Murres (*Uria aalge*) and Black-legged Kittiwakes (*Rissa tridactyla*), the most commonly monitored species in Alaska. The breeding biology and population trend of seabirds differed markedly between colonies relative to persistent geographic differences in forage fish abundance, which were in turn related to persistent oceanographic structuring of habitat in lower Cook Inlet.

Fifteen years have passed since these studies were completed, and little comparable work has been conducted during the interim (except for a USFWS study of seabirds at the Barren Islands colony). Anecdotal reports suggest that major ecosystem changes have occurred, including an ocean climate "regime shift" in 2008, that may have influenced the timing of breeding and reproductive success of birds on Gull and Chisik

Islands. Whether these changes have resulted in changes to the population trajectories observed in the 1990s remains unknown. A return to lower Cook Inlet to gather new data on seabird demography and forage fish communities will help establish the range of natural variability in population parameters in relation to environmental factors and provide an updated baseline of ecosystem condition in advance of new oil and gas leasing.

Objectives:

> Assess the current abundance, distribution and species composition of forage fish near the three main seabird colonies in lower Cook Inlet over two years (2016-2017).

> Census current populations of murres and kittiwakes at their colonies in lower Cook Inlet, and assess average levels of annual production over two years (2016-2017).

> Compare findings for fish and seabirds in 2016-2017 with data collected in 1995-1999, and relate trends to long-term environmental changes in ocean climate. Data synthesis and writing of papers/report will take place in 2018.

Methods: To facilitate comparisons with data from the prior studies, similar protocols for measuring food availability and seabird population biology will be employed, with some refinements. Forage fish abundance will be assessed using mid-water trawls and acoustic surveys around each colony. Densities of seabirds and marine mammals, and sea surface temperature/salinity will also be recorded continuously on transects. A CTD profiler will measure temperature, salinity, chlorophyll, and turbidity at depth on selected stations. The USGS vessel R/V *Gyre* will be used for these surveys, and was recently upgraded with all the equipment needed for this work. USGS will coordinate and collaborate with the NOAA Kasitsna Bay Laboratory in collection of oceanographic data. Forage fish and marine mammal survey data would also be shared with the proposed FY16 Cook Inlet Distribution of Cetaceans study. At the colonies, USGS will census kittiwakes and murres on established monitoring plots, measure reproductive success of adult birds, and collect data on diet composition of adults and chicks. USGS will coordinate and collaborate with the USFWS Alaska Maritime National Wildlife Refuge on studies of seabirds at Chisik and Barrens islands, and with the Seldovia Native Corporation for studies on Gull Island. Methods of data analysis will center on contrasting the functional responses of seabirds to prey fluctuations between decades of study, and relating trends in birds and fish to directly measured local changes in the environment and to larger scale indices of climate change.

Revised Date: May 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s): Cook Inlet

Administered By: Alaska OCS Region

Title: Marine Mammal Distribution, Abundance, and Ecology in Cook Inlet

BOEM Information Need(s) to be Addressed: Information is needed to establish spatial and temporal distribution and abundance of several species of marine mammals, including endangered species, that may be potentially affected by oil and gas activities on the OCS in Cook Inlet. This study will provide year-round documentation of temporal and spatial distribution, relative abundance, and functional areas for marine mammals including listed species and designated critical habitat to support NEPA analyses and to ensure compliance with the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA). Information collected on the seasonal and inter-annual distribution of marine mammals within these regions, as well as interchange between these regions and other foraging areas throughout Alaska, could inform design of temporal and spatial mitigation and monitoring of effects of activities. Results will support future Section 7 ESA consultations and preparation of future Biological Evaluations and Biological Opinions.

Approx. Cost: (in thousands) $2,500   **Period of Performance:** FY 2016-2021

Description:
Background: There are numerous species of marine mammals that occur within or near the area of potential OCS activity in lower Cook Inlet. Research directed at the population dynamics, habitat use and foraging ecology of humpback, fin and killer whales has occurred near Kodiak Island and in Prince William Sound, however there has been little direct effort within the study area, including the Barren Islands and Shuyak Island. Fin and humpback whales, which are endangered species, are known to be present in relatively high numbers year-round and seasonally feed intensively within and downstream of this area. Currently available data is insufficient to describe abundance, or seasonal use patterns of marine mammals in these areas, and ongoing monitoring efforts are aimed at beluga whales in upper Cook Inlet and sea otters in the mid-portion of the Inlet. The presence of several other cetacean species in the area, including sei, blue, gray, killer, and minke whales, as well as harbor and Dall's porpoise, is known but their seasonal distribution, relative abundance, and feeding hotspots are poorly documented. The spring and fall migration routes for most of the Eastern North Pacific gray whale stock are not well-defined at present. Non-cetacean species will be recorded as encountered, including seals, sea lions, and sea otters.

Some species of marine mammals may be adversely affected by routine and accidental operations associated with OCS oil and gas activities. For example, the acoustic environment used by many species of whales is notably altered by industry activities, including seismic surveys, shipping, drilling, construction, etc. There are potential effects on their ability to use sound to communicate, detect predators, find prey, and

navigate. Data indicate that underwater noise associated with high energy seismic exploration may cause some species or stock segments to avoid areas where seismic exploration is occurring.

Objectives:

Document the relative abundance, spatial, temporal, and functional use patterns of individuals and populations of marine mammals from the Forelands in the central Inlet south to the Barren Islands and Shuyak Island and the northern portion of Shelikof Strait.

Investigate the ecological factors responsible for the distribution of marine mammals in the study area with emphasis on the relationships between occurrence, distribution of potential prey, and oceanographic conditions, to assess the foraging habits and trophic roles of key species within the planned sale area and adjacent waters.

Estimate the degree of overlap and exchange between the Cook Inlet Planning Area and other known feeding areas within Alaska for marine mammals.

Methods: This study will provide year-round documentation on temporal, spatial, and functional use patterns of marine mammals in lower Cook Inlet and the entrance to Shelikof Strait through periodic aircraft and/or vessel-based surveys, and deployment of tags and continuous passive acoustic vertical recorder arrays. Oceanographic and prey species sampling will be conducted during vessel surveys, as the budget allows. Data from these various sources will be integrated to examine habitat relationships related to marine mammal activity. Biopsy samples may be collected for genetic, stable isotope and fatty acid analyses to investigate trophic relationships, and will be analyzed for gender identification, determining intraspecific relationships, tracking individuals over time, and as the budget allows, documenting environmental pollutants.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Arctic Ecosystem Integrated Survey, Phase II

BOEM Information Need(s) to be Addressed: BOEM needs a comprehensive assessment of both demersal and pelagic fish communities in the Chukchi and Beaufort Seas to improve benchmark information about the distribution, abundance, and life history of Arctic marine fish species. In particular, systematic surveys of the midwater fish community are currently lacking for the western Beaufort Sea. There is also a need for monitoring fish communities on a regular basis at least every 3-5 years to document variability and long-term changes. This information is needed to enhance environmental impact assessments, particularly with respect to early life history stages of key species such as Arctic cod (*Boreogadus saida*) and forage fishes, to develop indices and benchmarks against which to compare future changes, and to identify the distribution of the vulnerable life stages to facilitate development of effective mitigation measures.

Approx. Cost: (in thousands) $2,500   **Period of Performance:** FY 2016-2021

Description:
Background: Arctic fishes such as Arctic cod, capelin and saffron cod are key components of the Arctic food web and contribute to supporting large numbers of seabirds and marine mammals who migrate to the Arctic to take advantage of high seasonal production. There have been a variety of surveys with different gear types, primarily a small-mesh beam trawl sampling benthic fish resources. The first comprehensive bottom trawl surveys sampling larger fishes were conducted in the western Beaufort Sea in 2008 and in the Chukchi Sea in 2012. The first comprehensive surface and mid-water trawl/acoustic survey in the Chukchi Sea was conducted in 2012/2013. This survey documented for the first time large abundances of young-of-the-year Arctic cod in the northern Chukchi Sea. Their origin (spawning areas) and fate (nursery areas) are unknown at present.

A similar survey has not been conducted in the western Beaufort Sea, and the connectivity of fish populations between the Chukchi Sea and the Beaufort Sea has not been fully assessed. The proposed survey would repeat the 2012 Chukchi Sea survey in summer 2016 to allow direct comparisons of distribution and abundance of fishes and extend the survey around Barrow into the Beaufort Sea. It will provide the first synoptic assessment of fishes in the surface waters and in mid-water throughout the Beaufort Sea. To the extent possible, the spatial resolution of the survey and survey methods will be consistent with established survey designs that are routinely conducted by the National Marine Fisheries Survey in the Bering Sea to allow for geographical comparisons. The most recent targeted fisheries work in the offshore Beaufort Sea includes: the *Beaufort Sea Marine Fish Monitoring 2008: Pilot Survey and Test of Hypotheses* (OCS Study BOEMRE 2010-048); the *Beaufort Sea Marine Fish*

Monitoring Survey in the Central Beaufort Sea (AK-10-06); and the *U.S.-Canada Transboundary Fish and Lower Trophic Communities* (AK-12-04).

This project is a second phase of the study *Distribution of Fish, Crab and Lower Trophic Communities in the Chukchi Sea Lease Area* (AK-11-08a; AK-11-08b), also known as the *Arctic Ecosystem Integrated Survey* or Arctic Eis.

Objectives:

> Quantify the distribution, abundance, and condition of demersal fishes throughout the U.S. shelf waters of the Chukchi Sea and Beaufort Sea.

> Quantify the distribution, abundance, and condition of mid-water marine fishes, in particular young-of-the year Arctic gadids and forage fishes, throughout the U.S. shelf waters of the Chukchi Sea and Beaufort Sea.

> Establish whether juvenile salmon utilize the coastal waters of the Beaufort Sea during late summer and determine their likely origin.

> Test the hypothesis that a large under-ice spawning aggregation of Arctic cod in the northern Chukchi Sea serves as a source for Arctic cod in the Beaufort Sea, whereas saffron cod form local populations in the coastal waters of the Chukchi and Beaufort Seas.

Methods: Survey protocols will follow established methods such as those employed during the Arctic Ecosystem Integrated Survey (Arctic Eis) with sampling conducted from at least two platforms (bottom trawl survey, mid-water/acoustic survey and surface trawl survey). Sampling will be adapted based on Arctic Eis results and experience. In particular, mid-water/acoustic surveys will be the primary surveys in the northern Chukchi Sea and Beaufort Sea for assessing young-of-the-year and forage fish, while surface trawl sampling for juvenile salmon will be adaptive and exploratory as it is unknown if juvenile salmon utilize the Beaufort Sea. Oceanographic and plankton sampling in the Chukchi Sea will be coordinated with the recently funded *Arctic Marine Biodiversity Observation Network* (AMBON) project. However, the sampling design in the Chukchi Sea will likely differ from the transect-based AMBON design to more closely match the 2012 bottom trawl survey and 2012/13 oceanographic and fisheries surveys. The appropriate sampling design for the Beaufort Sea remains to be determined, but may proceed either along a grid or along a series of onshore-offshore transects. If resources permit, acoustic transects will be extended offshore to detect possible aggregations of Arctic cod along the slope and into the basin, based on similar surveys conducted in the Canadian Beaufort Sea.

Survey data will be combined with recent laboratory results on the growth of Arctic gadids and results from modeling possible transport pathways of particles from the Chukchi Sea to resolve the connectivity of Arctic cod and saffron cod between the Chukchi Sea and the Beaufort Sea. In addition, specimens collected during the surveys may be shared with a variety of researchers to further improve understanding of the biology of Arctic fishes (age & growth, genetic structure, energetics, trophic dynamics). Integration will occur from the benthos to the pelagic and the near surface waters, and will include fish, oceanography, and plankton sampling, coupled with seabird

observations. All components will provide inputs into an Integrated Ecosystem Assessment.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Algae, Zooplankton, Fish Profilers (AZFP) on Arctic
Moorings and Gliders

BOEM Information Need(s) to be Addressed: A better understanding of the annual cycle of primary and lower trophic production that underpins the entire foodweb is needed for environmental analyses. Improved accuracy and understanding of the year-round patterns and location of primary producers, zooplankton and arctic fish will better inform both the lower and higher trophic analyses in NEPA documents for lease sales, EPs, and DPPs.   The information will also support NEPA analyses of fish and their prey in fulfillment of EFH requirements.

Approx. Cost: (in thousands) $1,000   **Period of Performance:** FY 2017-2021

Description:
Background: Currently, BOEM relies heavily on data collected during the three month open-water season to understand how the Arctic ecosystem functions and supplies energy and nutrients to upper trophic predators year-round. These monitoring studies provide data across a wide spatial area but only at a narrow temporal span in the open-water season. Technology is now available to collect data through the full annual cycle, including the ice-covered season, using multi-frequency Algae, Zooplankton, Fish Profilers (AZFP) and Acoustic Doppler Current Profilers (ADCP) mounted on oceanographic moorings.

Data collected through a nested spatial and temporal sampling design can combine the two spatial and temporal scales synergistically to provide a greater understanding of the system. The utility of this approach in the Arctic was demonstrated in a 2013 U.S. National Science Foundation and Fisheries and Oceans-Canada study which put the AZFP-ADCP package through field tests to develop and apply acoustic methods adapted to the U.S. Arctic. Year-round data from the moored profilers are combined with species abundance from net tows and water samples to develop taxon-specific abundance estimates through the annual seasonal cycle. These acoustic method estimates will also improve and refine measures from standard BOEM monitoring surveys using standard nets to correct bias due to "catchability" of particular species and high variability of estimates due to patchy zooplankton distribution.

The AZFP instrument package consists of a battery powered AZFP pinging at 125, 200, 455, and 769 kHz fastened to a cabled 150 kHz ADCP. The four AZFP channels are pinged sequentially, repeated once a second, to assess the volume of different sized animals and plants that compose the plankton. Echograms are superimposed with temperature, salinity, and fluorescence profiles from the mooring. Comparison of the backscattering layers to the fluorescence profiles reveals station-to-station variation in community composition and ecosystem configuration.

<u>Objectives</u>:

Increase understanding of seasonal plankton cycles, particularly in the ice-covered and broken ice periods that comprise much of the yearly seasonal cycle.

Increase the specificity of knowledge about locations of biotic layers.

Enable deployment of more efficient and cost effective future baseline and monitoring efforts.

<u>Methods</u>: This project will develop a nested design to deploy AZFPs on oceanographic moorings and gliders at multiple spatial and temporal scales. Efforts will be made to minimize logistical costs through coordination of this project with other contemporaneous field research. Mooring data will be verified against open-water season samples. Multi-frequency AZFP data, in situ sampling, and ocean current data will be combined to develop seasonal abundance estimates.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s): Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Foodweb Simulation Models to Connect Humans and Marine Mammals with Lower Trophic Organisms

BOEM Information Need(s) to be Addressed: BOEM NEPA analysts need an innovative and cost-effective approach to analyze how oil and gas activities and climate change impacts may cascade through Arctic foodwebs and impact ecosystem services and key Arctic species. Foodweb simulation is particularly applicable to: cumulative effects analyses; fulfillment of EFH, ESA, and MMPA requirements; improvements in long-term monitoring; and to further develop mitigation measures in EPs, DPPs, permits, and Chukchi and Beaufort Sea Lease Sales.

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2017-2019

Description:
Background: The principles of adaptive management emphasize the importance of understanding baseline ecosystem function, including relative variability and resiliency of OCS marine ecosystems prior to and after development. BOEM analyzes local and regional effects of offshore development across large areas and over long time scales. In Alaska, the ability to differentiate between climate change and development effects is an especially challenging but essential part of NEPA analyses. Results from this project will help to identify specific species and ecosystem services for which protection and mitigation actions are advisable to avoid adverse impacts from offshore development.

The state of Arctic marine knowledge now makes possible the practical use of foodweb simulation models. Until now, Arctic OCS data was insufficient to feed ecosystem models and it was unclear whether existing models were transferable to Arctic ecosystems. Those circumstances have changed. BOEM baseline and monitoring surveys in Alaska increasingly include rapidly developing technology, particularly diet composition, fatty acid, and stable isotope techniques that trace energy transfer across trophic levels. These techniques provide the data needed to perform meaningful simulations that can help validate theories of how the Arctic ecosystem functions and may change with climate change and development. A recent Canadian study developed an Ecopath/Ecosym-based simulation that successfully separated climate change effects from other more direct human influences in an Arctic ecosystem.

This study will use foodweb data specific to the Arctic OCS to predict and test the sensitivity of how changes in one part of the foodweb may affect species and processes throughout the entire foodweb. It will evaluate the separate and cumulative effects of oil spills and climate change with OCS-specific data to better quantify and refine energy and ecosystem service linkages throughout the Arctic marine food chain, up to and including marine mammals and humans. The model can be manipulated to demonstrate how a particular impact at one level cascades through the ecosystem. It

estimates the biomass needed for each level to remain stable, thus identifying thresholds of change and tipping points that could cause the greatest harm to particular species and to the system as a whole.

Such a model would identify the sensitivity of one foodweb component to a change in another, allowing NEPA analysts assess proportional influence of changes on ecosystem processes to better evaluate and mitigate potential impacts. For instance, the model can test the hypothesis that 2014 observations of increased beluga whale foraging of spawning capelin aggregations and the concurrent low Arctic cod abundance may have been forced by climate change. The model could allow NEPA analysts to test the hypothesis that an oil spill on capelin spawning grounds will radiate up the food chain differently than an oil spill impacting Arctic cod spawning or that the hypothesis that small disturbances from offshore development have no detectable cascading impact through the larger ecosystem.

This study would specifically evaluate hypothesized effects of large and small oil spills and climate change on foodweb trophic levels from primary production to through the entire Arctic foodweb including marine mammals and human subsistence users.

BOEM-funded biological field studies will provide the majority of the model input data. BOEM sources of recent data include: ANIMIDA III monitoring; the *Central Beaufort Sea Fish Survey*; the *Transboundary Fish and Lower Trophic Communities Survey*; *Trophic Linkages Among Fish, Prey, and Seals*; the *Arctic Ecosystem Integrated Survey*; *Arctic Cisco Diet, Growth and Isotopes*; and the *Bowhead Whale Feeding and Ecology Study*. The model can be continually updated with new ecosystem data and study information to assess individual and cumulative impacts of reasonably foreseeable development activities.   Local traditional knowledge experts will be engaged to validate how well the simulations fit with their observations of foodweb connections, the role of humans in the system, climate change and adaptive responses in the system.

Objectives:

> Integrate BOEM foodweb and ecosystem data into a foodweb simulation model to improve analysis of ecosystem relationships and ecosystem services within NEPA documents.

> Derive Arctic ecosystem service and function inferences and test hypotheses relative to oil development, oil spills, and climate change both separately and together to provide better understanding of ecosystem processes for NEPA analyses.

> Identify additional marine mammal data needed to verify and improve the simulations.

> Support the Alaska Region efforts to engage local residents and small communities by involving them in validating the simulation results and by providing outreach and educational materials.

Methods: Using a model that accurately simulates Arctic foodwebs across trophic levels, this study will construct a quantitative Arctic foodweb. It will include primary producers, invertebrates, fish, birds, marine mammals and human subsistence use

components and incorporate available biomass, diet, and isotope, fatty acid data and current arctic ecological energy transfer theory. The researchers will focus particular attention on quantitatively accurate inputs for keystone and subsistence species and derive inferences and test hypotheses by simulating effects of development activity on the foodweb model. Oil-spill effects and climate change will be examined both independently and together to support cumulative effects analyses. The simulations and hypothesis test results will be used to identify ecologically significant tipping points, limiting ecosystem factors, robust ecosystem components, and potential mitigation strategies. Products from this study will include quantitative foodweb diagrams for use in NEPA analyses and recommendations for improvements and high priority data needed to refine the model and support future NEPA analyses.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Data Portal of Historical Acoustic Recordings to Quantify
                         Bowhead Acoustic Occurrence and Assess Variability in the
                         Acoustic Environment of the Chukchi and Beaufort Seas

BOEM Information Need(s) to be Addressed: As climatic conditions in the Arctic change and shipping and offshore energy activities increase, present environmental management plans designed to mitigate potential impacts on protected species and the environment may need to be modified for expected levels of future activities. Recent data from acoustic, satellite and visual studies suggest that the seasonal occurrence patterns, behavior, and ecology of the Bering-Chukchi-Beaufort (BCB) bowhead whale population are changing with associated changes in the region's marine species composition and the acoustic environment. An understanding of how marine mammal occurrence, species composition, and ambient noise conditions are changing, and the relationship to variations in environmental, biotic and anthropogenic conditions (e.g. ice melt primary productivity, ship traffic) can provide a basis for more effective and efficient management practices. This study will improve present understanding of historical and present marine mammal occurrence patterns to quantify and explain the multiple factors influencing the dynamics of the Alaskan Arctic acoustic ecosystem. This information will be used by BOEM for analyses of the potential effects of noise associated with OCS activities on marine mammals and to support development of mitigation of these potential effects.

Approx. Cost: (in thousands) $750   **Period of Performance:** FY 2017-2021

Description:
Background: Since the late 1970s acoustic recordings have been collected in areas inhabited by the BCB bowhead population to better understand this specie's distribution and trends. Recent recording efforts have broadened to include a diverse taxonomic suite of marine vertebrates, sampled over a broad range of Alaskan Arctic waters from the Bering Sea to the Canadian Beaufort Sea throughout the year. A brief review of all available acoustic recordings since 1978 indicate approximately 125 years of acoustic data have been collected in the BCB region. During summer 2009 through summer 2010 alone, a total of 69 autonomous seafloor recorders sampled the ocean acoustic environment over a 2300 km transect from the Bering Sea (62.2°N, -174.6°W) to the Canadian Beaufort Sea (70.8°N, -136.4°W). An initial look at these acoustic data provides insights into relationships between wind, ice, ambient noise and bowhead whale acoustic activity, demonstrating the ability to quantify the Arctic's acoustic environment, marine mammal occurrence patterns, and changing ecosystem dynamics.

The historical Arctic acoustic data sets have already been collected, but are distributed in multiple institutions, exist in different formats on different machines, and remain difficult to combine, though they are of sufficient quality and quantity to do so.

Integration of these acoustic data with the broad range of Arctic data collected throughout the same region and years would provide insights into the seasonal and geographic patterns of bowhead, and potentially other marine mammal, occurrence, as well as the dynamics and patterns of ambient noise throughout the region over recent decades. Timely access to these acoustic data has been dramatically improved and efficient analyses of very large acoustic data are now readily possible as a result of today's technologies, so that the full value of these extensive data sets can be used to maximum benefit.

This study will improve understanding of historical bowhead whale occurrence patterns to quantify and explain the multiple factors influencing the dynamics of the Alaskan Arctic acoustic ecosystem.

Objectives:

> Quantify the seasonal acoustic occurrence of bowhead whales (and bearded seals, beluga whales and walruses as available) along with spatio-temporal variability in the acoustic environment; and

> Test the hypothesis that the dynamics of certain factors (*e.g.* percent ice cover and ocean temperature) directly correlate with changes in bowhead whale occurrence patterns and features of the acoustic environment.

Methods: This study will develop a single database assembled from all available acoustic data and associated metadata collected from the Bering Sea to the Canadian Beaufort Sea regions from 1978 to the present. This will entail converting the acoustic data into a standardized digital format. The metadata related to the acoustic recordings will be entered into the open source Tethys temporal-spatial database. Advanced analytic and data visualization techniques will be used to quantify the seasonal acoustic occurrences of bowhead whales (and potentially other marine mammal species, such as bearded seals, beluga whales, walruses) and determine the spatio-temporal variability in the acoustic environment. A suite of advanced, user-friendly analytical and visualization tools will be developed to facilitate data access. Analyses may focus on the last decade initially, as it holds the greatest level of spatial and temporal acoustic sampling, and abuts the present conditions. Collaboration with experts in very large data systems and advanced data analytics is encouraged to develop capacity for open access to the data, analyses and visualization tools. This dataset will then be analyzed to assess whether there is a correlation between environmental (and if available anthropogenic) factors with bowhead whale (and if available other marine mammal species) acoustic occurrence, and to describe the spatial and temporal extent of existing patterns.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Chukchi Sea

Administered By: Alaska OCS Region

Title: Monitoring the Distribution and Habitat Use of Walruses
in the Eastern Chukchi Sea (Extension)

BOEM Information Need(s) to be Addressed: Data on the seasonal distribution and habitat use of walruses are needed to assess and manage anthropogenic risks and environmental effects of Chukchi OCS exploration, development and production on marine mammals. Information on these ecological parameters in the Chukchi Sea need to be evaluated in consideration of the loss of sea ice habitat and ecological changes that have occurred in recent years. This study will provide real-time information about walrus use of the eastern Chukchi Sea during the sea-ice minimum season that can be used to avoid disturbance to walruses in their primary feeding area (Hanna Shoal) and once they come onshore when the sea ice retreats north of the continental shelf (as has happened in 6 of the 8 last years). Analysis of the data from multiple years will be used for NEPA analyses for lease sales, EPs and DPPs, MMPA authorizations, and ESA consultations. This study will also contribute information useful for developing mitigation strategies to reduce impacts to walruses from potential oil and gas exploration and development and production activities.

Approx. Cost: (in thousands) $1,900   **Period of Performance:** FY 2017-2021

Description:
Background: USGS initiated a study in 2007, and expanded the study in subsequent years (with BOEM funding), to determine the seasonal distribution and habitat use of walruses in the Chukchi Sea. A report on walrus utilization areas in 2008-2011 was published in 2012. However, patterns of utilization are still being established by walruses in response to continued reductions in sea ice habitats in the Chukchi Sea. Exploration and drilling activities on the Chukchi Sea OCS are expected to occur in the coming years. Therefore, the monitoring initiated by USGS needs to continue without interruption through at least the next five years to provide information through the period of exploration activity and describe changes in walrus distribution associated with changing sea ice habitats. Information regarding the seasonal distribution and habitat use of walruses across the planning area is required for assessing potential impacts and mitigating disturbances associated with proposed exploration and development scenarios.

The USFWS, in collaboration with the Alaska Department of Fish and Game, ChukotTINRO, the Association of Traditional Marine Mammal Hunters of Chukotka, and the Eskimo Walrus Commission, secured funds to initiate a genetics-based mark-recapture project for estimation of abundance and demographic rates of walruses in FY 2013. This proposed study will incorporate the findings of the USFWS study to tie the abundance estimation data with the distribution and habitat use data to gain a more

complete picture of the population status of walrus in the Chukchi Sea and to advance knowledge of habitat use.

Objectives:

Identify important walrus habitats in the eastern Chukchi Sea.

Evaluate whether foraging areas are changing over time with increased use of nearshore habitats.

Provide real-time information on walrus distribution and movements in areas of oil and gas exploration activity on the Chukchi Sea OCS.

Methods: Researchers will deploy up to 30 transmitters each year on walruses in the sea ice after they have entered the Chukchi Sea using small boats launched from a larger ship. They will also deploy up to 20 transmitters on walruses when they begin using land haulouts in fall. Deploying tags on walruses using land haulouts is necessary to obtain data on foraging areas used once the sea ice has receded north of the continental shelf. The tags continuously record haul-out and foraging state. The average longevity of the deployed tags is about 6 weeks. Therefore, to obtain tracking and behavior data from walruses while using offshore and onshore haulouts, we will attach tags on walruses in July and again in September in each of the field study years. Researchers will also continue to develop new tag designs in an effort to extend tag longevity. Radio tags will be attached primarily to adult females. Each tag is fitted with a barbed head that embeds in the animal's blubber layer on impact. Chronologies of the hourly haul-out and foraging state of tagged walruses will be derived from data collected by a conductivity sensor and pressure transducer on the radio tag.

Data on walrus movements and foraging behaviors will be used to provide near real-time web-based animations of walrus movements, update walrus utilization distributions that USGS published in 2012, and develop habitat selection and state-space models. These analyses will use data on the foraging status and locations of tagged walruses, pertinent ice data available from the National Snow and Ice Data Center, and datasets of benthic infaunal surveys from various sampling programs sponsored by government and industry.

This project would be co-funded with USGS.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Enhanced Verification and Interpretation of Freeze-up
        Conditions for the Northeast Chukchi Shelf

BOEM Information Need(s) to be Addressed: BOEM analysts and managers seek more detailed spatio-temporal information pertaining to seasonal freeze-up conditions at specific planned drilling locations on the Alaska OCS. More reliable and extensive information is particularly needed during the late open-water season when storm activity is anticipated, and during the seasonal freeze-up period when frazil ice formation and pack ice intrusions create environmental concern for safe operations. Additional information pertinent to understanding the physical processes associated with freeze-up and associated forces that greatly impact Arctic offshore operations is also needed. Study products will support NEPA analyses, including EISs and EAs, and related decision-making. This research will also support current and future information needs of BSEE to further enhance knowledge of ice, ocean, and atmospheric conditions pertaining to operational capabilities when working in the Northeast Chukchi Sea, and during BSEE regulatory review of applications for permit to drill (APD; 30 CFR §250.417).

Approx. Cost: (in thousands) $2,000   **Period of Performance:** FY 2017-2021

Description:
Background: Real-time information on ice, ocean and weather conditions, along with improved ice forecasts for the Chukchi Sea, are important considerations for maritime traffic and vessel safety, as well as for evaluating potential storm impacts on the coast. In addition, accurate forecasts of freeze-up conditions are especially valuable for the remote coastal communities in northern Alaska where fuel, durable goods and food are primarily resupplied by barge, and decisions are required 10-12 days in advance for delivery from west coast ports.

Operational capabilities during potentially hazardous ice and freezing spray conditions within the Chukchi Sea are also a major concern for BSEE and BOEM. Recently, BOEM developed a restriction on certain late season drilling operations within the Chukchi Sea to allow a greater opportunity for oil-spill cleanup and response time in ice-free conditions. This mitigation measure, implemented with respect to a Chukchi Sea exploration plan, was established "in consideration of the distance to limited support infrastructure on the Chukchi coast, as well as limited drilling experience in the Chukchi Sea, and in keeping with the Secretary of Interior's desire to proceed cautiously with oil and gas development in the Chukchi Sea." The mitigation measure states that "No exploratory drilling will be allowed below the last casing point set prior to penetrating a zone capable of flowing liquid hydrocarbons in measurable quantities into the well within 38 days of a 'trigger date' established each year by BOEM, based upon the date of first ice encroachment over the drill site within any of the last five years." For

exploratory drilling activities in 2012, BOEM calculated a "trigger date" based on 2007-2011 interpreted sea ice data from the National Ice Center (NIC). The trigger date provides a conservative assessment of when the first new ice or pack ice could first encroach upon the proposed drill site during the end of the exploratory drilling (open water) season for the Northeast Chukchi Sea.

Objectives:

Document the atmospheric and oceanographic conditions that initiated freeze-up conditions on the northeast Chukchi shelf between 2006 and 2014.

Provide atmospheric, oceanographic, and sea ice data to the BOEM Sea Ice Database at the required scales that will produce more accurate assessments of freeze-up conditions between 2006 and 2014 and beyond.

Obtain a comprehensive understanding of the processes and feedback mechanisms that drive the ice-ocean-wave-atmosphere system by documenting the physical ice, ocean, and atmospheric processes controlling freeze-up within active lease areas.

Provide real-time ice, ocean, and atmospheric data from this study to BOEM for incorporation into the BOEM Sea Ice Database for the purpose of improving BOEM's internal forecasting capability.

Provide standardized real-time data to the National Weather Service (NWS) Forecasters, National Ice Center (NIC) Ice Analysts, and to NOAA modelers to improve late season modeled forecasts of freeze-up conditions.

Coordinate with BOEM, BSEE, the National Weather Service forecasters, National Ice Center ice analysts and NOAA modelers to produce improved "weather scale" forecasts of freeze-up conditions.

Methods: Researchers will collect and analyze historical ocean, ice, wave and atmospheric field data (2006-2014) that best explains the dynamic environment processes that govern the seasonal freeze-up of sea ice. They will design and implement a comprehensive field program that will provide real-time data to forecast the timing of new ice formation during the fall freeze-up period. Instrumentation may include: High frequency Radars, drifters, gliders (AUVs) and the design and development of new sensors. Real-time data will be provided to NOAA for use by modelers, ice analysts and National Weather Service forecasters. Researchers will develop a project web portal which can provide near-real-time information on the ocean, atmosphere, and sea ice conditions and display graphical hindcasts and forecasts of freeze-up conditions. BOEM will collaborate with the State of Alaska (University of Alaska Fairbanks and other State entities) in assessing ice conditions during the freeze-up period to ensure that there is sufficient time to track and work towards cleaning up a potential offshore spill from OCS activities.

Revised Date: April 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Beaufort Sea, Chukchi Sea

Administered By: Alaska OCS Region

Title: Archaeological Resource Baseline Study for the Beaufort
                          and Chukchi Seas

BOEM Information Need(s) to be Addressed: BOEM needs to improve
identification of significant archaeological sites, such as traditional cultural properties,
built environment resources, shipwrecks, and potential culturally sensitive submerged
landforms that offshore activities may directly or indirectly impact. These data are
necessary to fulfill BOEM's responsibilities under the National Historic Preservation
Act, as amended (NHPA). The results of this study will be used towards National
Environmental Policy Act (NEPA) analyses for Environmental Impact Statements (EISs)
and Environmental Assessments (EAs) and in the evaluation of future exploration,
development, and transportation plans for offshore energy projects.

Approx. Cost: (in thousands) $475   **Period of Performance:** FY 2017-2019

Description:
Background: BOEM has completed, or is in the process of completing, baseline studies
of known and reported submerged cultural resources in each OCS Region off the
contiguous U.S. and Hawaii. No such baseline study, however, has ever been completed
off northwestern Alaska in the Chukchi Sea for any federal agency. As a result, there is
very limited information currently available regarding potential submerged cultural
resources in the Chukchi Sea, even though the potential is enormous for identifying
early man sites due to Beringia, a land bridge of continental scale that formerly linked
Alaska with Siberia. The archaeological significance of offshore areas has been
recognized in recent years, and marine archaeological studies have shown the presence
of late Pleistocene–early Holocene (LP-EH) sites on the shelves beneath the modern
ocean. Alaska has a unique importance in the study of LP-EH archaeology since it has
long been believed that humans migrated across a land bridge that formerly linked Asia
with North America—so the protection of any possible offshore archaeological evidence
is paramount. Much important new information on LP-EH archaeology has been
published since the last Archaeological Baseline Study in the Beaufort Sea, including the
timing and migration routes and modes of the first Americans, and this information
needs to be integrated into a formal study to guide the BOEM archaeological resources
preservation program.

New information, such as the results from the study *Review of Geological/Geophysical
Data and Core Analysis to Determine Archeological Potential of Buried Landforms
Beaufort Sea Shelf, Alaska* (OCS Study MMS 2007-004) in the Beaufort Sea and United
States Geological Survey (USGS) findings during the 1990s of 10,000-year-old
preserved terrestrial sediments in the Chukchi Sea, has not been accounted for in a
more current Archaeological Baseline Study.   OCS Study MMS 2007-004, which was
designed to assess the LP-EH archaeological potential for shallow water paleo-

terrestrial features in the Beaufort Sea, indicated that buried and drowned terrestrial sediments and associated landforms are less than 10,000 years old (between 1600-8600 years old). This means that these features may have seen human occupation and have potential for archaeological resources. There also exists potential for these resources in the Chukchi Sea.

Objectives: The baseline study will synthesize all existing geologic, paleo-environmental and archaeological data for the Beaufort Sea and Chukchi Sea area to:

> More clearly define the relationship of LP-EH human populations to the paleo-landscape.

> Accumulate baseline information on submerged and terrestrial cultural and archaeological sites and site types - define the size, type, and ages of sites to be anticipated in the offshore area.

> Develop paleo-landscape reconstructions to help predict submerged prehistoric site locations.

> Define how site densities fall off with increasing distance from the various types of landforms.

Methods: The proposed study will collect information from archival and secondary sources of known, reported, and potential archaeological sites on the Alaska OCS in the Chukchi and Beaufort Seas, including the aforementioned OCS Study MMS 2007-004 and the results from *Evaluation of Sub-Sea Physical Environmental Data for the Beaufort Sea Alaska OCS and Incorporation into a Geographic Information System (GIS) Database* (OCS Study MMS 2002-017) and its update (proposed for FY 2016); collect ethnographic information from Alaska Native entities from Point Hope to Kaktovik regarding traditional use of various landscapes similar to those now submerged-oral histories on this topic have not been collected since Knud Rasmussen's efforts on the Fifth Thule expedition, 1921-1924 (respected Iñupiat leaders recall stories told by their parents, long deceased, of use of now submerged lands thousands of years ago); interpret and analyze paleo-landforms; synthesize this information to develop paleo-landscape reconstructions and prepare a final report of findings that provides a model of potential settings and site types that can be expected in the project area. This information will also contribute information layers on known and reported submerged cultural resources for the GIS digital database in the update of OCS Study MMS 2002-017 (proposed for FY 2016).

Revised Date: June 8, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Long-Term Coral Reef Monitoring at the Flower Garden
Banks, Gulf of Mexico: 2016-2018

BOEM Information Need(s) to be Addressed: NOAA and BOEM will continue the ongoing financial partnership to support the Long-Term Coral Reef Monitoring Program within the Flower Garden Banks National Marine Sanctuary (FGBNMS). The monitoring protocol shall be consistent with past BOEM contracts for monitoring the coral reefs of the East and West Flower Garden Banks (FGB). The primary objective of this study is to assess the health and vitality of the coral reefs and to provide an analysis of the status of coral reefs in comparison with historical data. This information will be utilized by BOEM and NOAA to design management policies minimizing impacts to coral reefs from offshore oil and gas activities, as well as other factors. This program will be carried out as a collaborative partnership.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2016-2018

Description:
Background: The coral reefs of the East and West FGB are well documented to be among the healthiest in the western Atlantic and Caribbean region. While many coral reefs have experienced significant declines in coral cover and vitality, the reefs of the FGB remain in relatively stable condition. Coral reefs are focal points for marine biodiversity, provide critical habitat for a variety of fish and invertebrate species of commercial and recreational importance, supply valuable public recreational opportunities, and contribute to local and regional economies. The health of coral reefs may be threatened by a number of potential sources, including direct and indirect impacts from human activities. Due to concern about potential impacts of offshore oil and gas development, DOI (through the Minerals Management Service – now BOEM) started monitoring the East and West FGB in 1988 to assess the health of the coral reefs to establish baseline data and determine if these reefs were impacted by nearby OCS exploration and production activities.

This study is designed to monitor environmental conditions of the coral reefs at the East and West FGB located within the FGBNMS (or Sanctuary). The biological health of the coral reef community shall be monitored to detect any significant effects from natural and/or human-induced activities that could potentially endanger the coral community integrity. Surveys at both the East and West FGB shall be performed over a two-year period. Annual 5-day data collecting cruises on each bank shall be conducted during late summer or early fall (generally August or September) each year of the agreement.

Objectives: The objectives for this long-term monitoring effort is designed to assess the health of the coral reefs, through the evaluation of changes in living coral and other benthic community cover, coral growth rates, reef fish population dynamics, water

quality and other indices of reef vitality. This program is of significant interest to both NOAA and BOEM, whom share responsibility to protect and monitor these important marine resources.

Methods: Observations shall be made to evaluate coral reef diversity, growth rates, and long-term changes in individual coral colonies, accretionary growth, and general coral reef community health during years 2014 and 2015. In general, survey techniques are listed and described in detail in monitoring reports from previous reporting periods (*Long-term Monitoring at the East and West Flower Garden Banks 2011-2012* (IA No. M09PG00011). The following is a summary of the current monitoring methods that will be continued within each study site:

a) Sixteen (16) photographic transects ten (10) meters in length shall be taken in a stratified random manner with four (4) transects randomly located in each quadrant of each study site. Starting points of transects within study sites shall be randomly located using statistically valid methods.

b) Forty (40) repetitive quadrat stations shall be maintained in each study site to detect and evaluate long-term changes in individual coral colonies. Eleven (11) repetitive quadrat stations at the East FGB and twelve (12) repetitive quadrat stations at the West FGB shall also be maintained at depths between 100 and 130 feet.

c) Thirty (30) permanent stations for monitoring growth of the scleractinian coral *Psuedodiploria strigosa* shall be maintained in each study area.

d) Cores of *Orbicella faveolata* coral colonies shall be taken on each bank during the second sampling cruise.

e) A minimum of two (2) videotaped transects of 100 m length shall be flown at each site to show the general conditions of the coral and to help document the condition of certain individual coral heads and other features for future reference.

f) Fish counts shall be performed at both banks using both the Reef Visual Census (RVC) (Bohnsack & Bannerot, 1986) stationary visual technique and belt transect technique (NOAA, Center for Coastal Monitoring and Assessment) for quantitatively assessing community structure of coral reef fishes.

g) Eight (8) of the 16 random transects mentioned in requirement a), will be utilized to conduct coral recruit and colony size surveys.

h) *Diadema antillarum* (long spined urchin) surveys shall be conducted to establish current population levels as a basis for comparison with future observations.

i) In addition to *Diadema antillarum* surveys, *Panulirus argus* (spiny lobster), *Panulirus guttatus* (spotted lobster), and *Pterois volitans* (lionfish) surveys shall be conducted in conjunction with *Diadema antillarum* surveys along study site boundary lines.

j) Water quality instruments deployed long-term in the field shall be serviced and all data downloaded at least four times each year at approximate three-month intervals.

k) A minimum of three (3) water samples shall be collected quarterly at both banks at the surface, mid-water, and near bottom using a vertical 10 liter sampling

bottle and analyzed for chl *a*, ammonia, nitrate, nitrite, TKN, and phosphorous. The samples shall be analyzed by an approved EPA certified laboratory.

Revised Date: January 6, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico and Central Gulf of Mexico

Administered By: Gulf of Mexico Region OCS

Title: Year 2017 Gulfwide Emissions Inventory Study

BOEM Information Need(s) to be Addressed: First, the collection and compilation of an air emissions inventory is one of the tasks that BOEM conducts to assure coordination of air pollution control regulations between Outer Continental Shelf (OCS) offshore sources and state's sources onshore. Second, this emissions inventory will be useful for compliance with USEPA's Greenhouse Gas Reporting Rule. Finally, BOEM will also use the 2017 emissions inventory to support the OCSLA and NEPA process when preparing Environmental Impact Statements and Environmental Assessments, and for emissions trends and impacts analysis.

Approx. Cost: (in thousands) $1,000   **Period of Performance:** FY 2016-2019

Description:
Background: The 1990 Clean Air Act Amendments (CAAA) requires the U.S. Environmental Protection Agency (USEPA) to set the National Ambient Air Quality Standards (NAAQS) for widespread pollutants from numerous and diverse sources considered harmful to public health and the environment. The law also requires the USEPA to periodically review the standards to ensure that they provide adequate health and environmental protection, and to update those standards as necessary. The USEPA has set standards for six primary pollutants and has added 1-hour nitrogen dioxide (NO_2) and 1-hour sulfur dioxide (SO_2) standards and has proposed to lower the fine particulate matter ($PM_{2.5}$) and ozone 8-hour standards.

Because of the continuing needs of addressing these standards, regulations may require state agencies to perform air quality photochemical modeling for use in their State Implementation Plans (SIPs). In order to conduct this modeling, emission inventories must be generated as inputs to the models. The 2017 gulf-wide emissions inventory will be available to assist states in conducting modeling for additional SIP demonstrations to meet the changing requirements. The collection and compilation of an air emissions inventory is one of the tasks that BOEM 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 CAAA specify that states are to prepare emission inventories every three years. The proposed 2017 gulf-wide emissions inventory will correspond with the next periodic USEPA onshore emissions inventory.

The USEPA has also issued the Final Mandatory Reporting of Greenhouse Gases Rule (October 30, 2009). OCS facilities that emit 25,000 metric tons or more per year or greenhouse gases emissions in a CO_2 equivalent must submit annual reports to the USEPA for carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The

proposed 2017 inventory will include these greenhouse gases emissions that will assist the OCS operators with their mandatory reporting of greenhouse gases to USEPA, according to USEPA's Subpart W.

Lastly, the inventory will be used by BOEM to support OCSLA, which states OCS oil and gas sources can't significantly impact the air quality of any State, and the Government Accountability Office (GAO), which wants to reduce methane and fugitive emissions.

Objectives: The purpose of this study is to develop a year 2017 gulf-wide 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), lead (Pb), ammonia (NH_3), carbon dioxide (CO_2), methane (CH_4), nitrous oxides (N_2O) and relevant hazardous air pollutants (HAPs) to support states in writing their SIPs, to support operators in their mandating reporting of greenhouse gases to the USEPA, and to support BOEM in their NEPA process and impact assessments.

Methods: The contractor will collect and compile emissions activity data from the platform and non-platform sources on the OCS, will obtain the most recent emissions factors per source per pollutant, and will calculate all emissions of the air pollutants, as above. Some of the platform sources include diesel engines, drilling equipment, combustion flares, fugitives, glycol dehydrators, natural gas engines, natural gas turbines, pneumatic pumps, storage tanks, and cold vents. Because the past BOEM emissions activity software's program code is no longer supported, the contractor will have to design new software, and/or perhaps an electronic reporting submittal, which will not only collect the activity data, but also calculate emissions at the submittal level. Because of this new software and submittal process, the budget for this emissions inventory study has increased in relation to past emissions studies. In addition, activity data from non-platform sources will be collected using Automatic Identification System (AIS), surveys, or other appropriate sources, and emissions will be calculated using the most recent emissions factors per source. Some of the non-platform sources include drilling rigs, pipelaying sources, support helicopters, support vessels, survey vessels, and possibly stimulation vessels hydraulic fracturing emissions, if appropriate. The contractor will quality control and assure all data collected. The contractor will calculate a total emissions inventory by source and by pollutant and generate emissions inventory databases that will comply with USEPA current formats and will be approved by BOEM.

Revised Date: January 12, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Surveying and Testing Submerged Paleolandform Features in the Western Gulf of Mexico: The McFaddin Beach Project

BOEM Information Need(s) to be Addressed: As a Federal agency, BOEM is required to consider the potential impacts of bureau-permitted activities on cultural resources under the National Historic Preservation Act (NHPA) of 1966, as amended. The Bureau fulfills this obligation, in part, by requiring oil and gas operators to commission a remote sensing survey and archaeological assessment of the area intended for exploration and development before seafloor-disturbing activities commence. Archaeological surveys are also required for OCS marine mineral resources intended for coastal restoration projects to determine if they contain preserved archaeological remains. Identifying and testing the geophysical indicators of preserved paleolandforms in the northwestern GOM and their potential for containing cultural materials will allow BOEM to more adequately identify, protect, and manage these submerged cultural resources while ensuring BOEM-permitted oil and gas and marine minerals activities do not impact them. Though no submerged prehistoric sites have been identified on the OCS in this region, evidence of redeposited cultural materials from an unidentified source has been found. Along the southeast coast of Texas, Late Paleoindian and Archaic Period artifacts and fossilized faunal remains have washed up on McFaddin Beach over several decades. Previous studies and geophysical investigations have not yet identified the source of these archaeological materials. It is hypothesized that intact deposits containing cultural materials lie offshore of McFaddin Beach and may yield important information not only about prehistoric sites within the now-submerged OCS but also coastal geomorphological and climate change in this region over time. This study will test recommended survey methodologies and inform best management practices for submerged prehistoric sites in the Western GOM OCS.

Approx. Cost: (in thousands) $20   **Period of Performance:** FY 2016-2018

Description:
Background: BOEM has previously funded studies to obtain a better understanding of the potential for intact submerged prehistoric sites on the OCS as well as assess the effectiveness of BOEM survey methodology guidelines. In the 1980s, BOEM (then MMS) funded a study in the Sabine River Valley to test the predictive model and recommended survey methodology proposed by earlier studies to identify paleolandforms with a high probability for containing cultural materials (Pearson et al. 1986). A recent study in the GOM, "*Examining and Testing Potential Prehistoric Archaeological Features on the Gulf of Mexico, Outer Continental Shelf*" (GM-92-42-136), tested three potential submerged archaeological features initially interpreted as middens but could not confirm that these features were unequivocally associated with prehistoric human occupation and activity. Another study, "*Response of Late*

Quaternary Stream and Estuarine Systems to Holocene Sea Level Rise on the Outer Continental Shelf Offshore Louisiana and Mississippi: Preservation Potential of Paleolandscapes and Identification of Sand Resources for Coastal Restoration" (GM-09-01-10), is compiling and examining existing high-resolution seismic, sub-bottom profiler, and core data from various sources into a single GIS database for offshore Louisiana and Mississippi but does not include the OCS off the Texas coast. A previous study of McFaddin Beach by BOEM (then MMS) (Stright et al. 1999), conducted a geospatial analysis of artifacts from a secondary deposit along the beach and inferred that one possible source of these artifacts could be an intact deposit offshore. A study currently underway in the Atlantic OCS Region, "*Developing Protocols for Reconstructing Submerged Paleocultural Landscapes and Identifying Ancient Native American Archaeological Sites in Submerged Environments,*" is developing a model for reconstructing submerged paleolandscapes off the New England coast and recommending best practices protocols for identifying such features. However, the results of this study will have limited applicability in the northwestern GOM as this area is geologically distinct from the New England region and was subject to different climate conditions, factors which affect preservation potential.

Although submerged prehistoric sites have been identified in the Eastern GOM off the coast of Florida, no similar sites have been unequivocally confirmed in the Central or Western GOM. Sedimentary erosion and deposition in the northwestern GOM represent distinct events related to fluvial incision and subsequent backfilling of valleys related to sea-level fluctuations, variations in continental sediment supply to the coast, and rate of relative (local) sea level rise—processes which did not occur uniformly across the entire Gulf region. Therefore, preservation potential of sites in the northwestern GOM is hypothesized to be high if intact cultural deposits were located within entrenched relict river valleys, covered by estuarine deposits, *and* subject to a low energy environment during marine transgression. This study intends to identify paleolandforms offshore of McFaddin Beach through geophysical survey and review of existing datasets held by Federal and Texas State agencies and to test deposits representing potential paleolandforms for preservation potential and presence of archaeological materials.

Objectives:

- Assess the potential for and identify paleoenvironmental and geological conditions that could have supported preservation of intact archaeological deposits in the northwestern GOM OCS and develop a stratigraphic evolutionary model to better define vertical relationships;

- Test the effectiveness of previous studies' recommended enhancements to the survey methodology and pattern currently prescribed by BOEM (NTL 2005-G07; currently 300 m survey transect spacing) as well as other recent methodological suggestions for identifying potential submerged prehistoric archaeological sites on the OCS (for example, initial survey at 100 m transect spacing followed by 30 m or less transect spacing within specific areas of interest) and recommend any additional modifications or enhancements to the survey guidelines as appropriate;

- Test alternate hypotheses of an offshore source with possible intact deposits eroded by shoreface processes versus an updrift source associated with ex situ cultural materials redeposited on McFaddin Beach;

- Recommend best management practices for identifying and testing intact paleolandscape features on the OCS to ensure that submerged prehistoric sites are not impacted by BOEM-permitted activities.

Methods:

- Compile existing geophysical datasets and conduct additional geophysical surveys and vibracoring (or other appropriate techniques) within Texas State waters, and possibly in Federal waters, off McFaddin Beach to identify and test potentially preserved and intact paleolandforms that may contain cultural materials associated with Paleoindian- and Archaic-era human occupation of the OCS;

- Conduct diver investigations, diver and vessel-based coring, and limited test excavations and artifact collection to inform on the presence/absence of archaeological deposits and cultural materials;

- Collect sediment, floral/faunal, and other relevant samples as necessary to inform paleoenvironmental reconstructions and analysis of climate change over the last 10k-20k years in this region.

Potential study partners and collaborators who would bring additional funding and in-kind support to the study include Texas State University's Gault School for Archaeological Research and Meadows Center for Water and the Environment; the University of Texas Institute for Geophysics; Texas Historical Commission; Smithsonian Institution's National Museum of Natural History, Department of Anthropology; BSEE; U.S. Naval Research Laboratory; and the University of Exeter.

Revised Date: May 12, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Areas: Western Gulf of Mexico and Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Socioeconomic Impacts of OCS Infrastructure: Shifts in
                                    Recreational Behaviors

BOEM Information Need(s) to be Addressed: Offshore recreational activities, such as fishing and diving, contribute significantly to the social and economic frameworks of many communities along the Gulf Coast. However, the existing literature does not adequately describe the extent to which certain recreational activities are dependent on OCS infrastructure. In addition, technological advances, social changes, regulatory changes, and economic events have likely changed patterns of recreational behavior. This study would describe and quantify the recreational uses of OCS infrastructure. The information obtained from this study would improve BOEM's pre-lease and post-lease NEPA analyses. For example, this study would allow BOEM to more accurately estimate the distances from shore that BOEM activities and recreational activities interact in various locations. This study would also improve BOEM's estimates of the economic benefits of OCS infrastructure, which would improve BOEM's NEPA and OCSLA Section 18 economic analyses. This study would also inform decisions regarding which structures should be maintained through Rigs-to-Reefs programs.

Approximate Cost: (in thousands) $500   **Period of Performance:** FY 2016-2019

Description:
Background: Offshore recreational activities, such as fishing and diving, contribute significantly to the social and economic frameworks of many communities along the Gulf Coast. In 2011, recreational fishing alone contributed an estimated $4.4 billion in sales and $2.2 billion in value-added benefit to the combined economies of Texas, Louisiana, Mississippi and Alabama (USDOC, NMFS, 2012). This activity supported an estimated 42,272 jobs. However, the data provided by the NMFS does not describe how much of this economic activity is dependent on OCS infrastructure.

Hiett and Milon (2002) provided some information regarding the overall scale of fishing and diving near oil and gas platforms; it also estimated the economic impacts arising from expenditures by these fishermen and divers. However, that study was based on 1999 data and is therefore becoming less applicable as the recreational landscape changes. In addition, that study did not examine certain subcategories of these activities, such as the scale of recreational fishing and diving that occurred in state versus federal waters. Hiett and Milon (2002) also did not examine site-specific determinants of recreational uses of OCS infrastructure. In addition, there are no readily available estimates of the socioeconomic contributions generated by other recreational activities (such as offshore birding and invasive species management) occurring near OCS infrastructure.

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Since the Hiett and Milon (2002) study, there have been technological advances, social changes, regulatory changes, and economic events with the potential to significantly alter recreational behavior along the Gulf Coast. For example, improved offshore communications (e.g., satellite and cellular), increased safety (e.g., Emergency Position-Indicating Radio Beacons (EPIRB), weather satellite services), and simplified navigational aids (e.g., GPS) have allowed the OCS to become increasingly accessible to recreators. Technological advances support increased travel distances, trip durations, and activity intensity (site saturation, multiple activity use, and precise site targeting). Improved safety promotes participation in offshore recreational activities by a broader range of individuals. Public awareness of the oceans, environmental impacts, and climate change have resulted in increased ecotourism and other low-impact recreational activities. Furthermore, the nation recently experienced a long, deep recession and is now in recovery. How these factors have acted individually or in combination to impact recreational activity in the GOM and the coastal communities and businesses reliant upon recreational spending is not known. It is also unknown to what extent OCS oil and gas activities affect recreational activities and whether potential impacts are beneficial or detrimental.

Recreational activities have been associated with nearshore infrastructure for decades. However, as unsafe, obsolete and non-productive OCS structures are removed and fewer nearshore structures are installed, individuals and communities have to adapt to a changed recreational landscape. In particular, the number of oil and gas production facilities in the GOM federal OCS area fell from a peak of 4,049 at the end of 2001 to 2,634 at the end of 2013 (BSEE, 2014). Some recreational users have had long-term interactions with nearshore structures and may equate structure removals to losses of recreational resources. In this case, users of nearshore OCS waters may be undergoing a shift in recreational behavior, resulting in increased preference for recreational activities farther offshore, different nearshore locations, or curtailment of activities. This changing recreational behavior may cause a redistribution of economic benefits or reduced recreational spending. The addition of artificial substrate to areas suitable for fish habitat and conducive to recreational fishing and diving may encourage participants to continue pursuing activities locally. Fishermen and divers accustomed to the presence of OCS infrastructure might also benefit from outreach programs regarding the distributions of habitat and fishes in the Gulf, and recreational techniques suitable to the changed landscape. The findings from this study will help BOEM, recreators, businesses and communities to adapt to this changed landscape.

Objectives:

1. Assess recreational demand for OCS infrastructure.

2. Assess recreational demand for Rigs-to-Reefs associated artificial reef sites.

3. Identify key factors for structures particularly suitable for recreational activities.

4. Identify and evaluate behavioral shifts (and anticipated shifts) resulting from removal of obsolete OCS infrastructure.

5. Quantify the social and economic impacts of OCS infrastructure.

<u>Methods</u>: A methodology that entails conducting field interviews, telephone interviews, and written surveys will be developed to address the objectives of this project.   This methodology will obtain information from recreators and firms that provide recreational services. Objectives 1 and 2 will be addressed fairly directly through the interviews and surveys; Objectives 3 and 4 will be addressed through a combination of direct questions and statistical inference techniques. The methodology will assess the overall scale of fishing, diving, and other recreational activities that depend on OCS structures. This will entail clarifying the scale of recreational use in certain areas, as well as clarifying the percentage of activities that occur near OCS structures; these methods will lead to various GIS-based maps. This methodology will also obtain information on site-specific determinants of recreational use, as well as information on the substitutability of recreational sites. To the extent that appropriate methodologies exist, as well as the extent to which budget considerations allow, this project will also entail a statistical analysis of the interview and survey data in order to quantify the economic impacts of recreational uses of OCS structures (Objective 5).

Revised Date: April 29, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico and
                         Eastern Gulf of Mexico, Mid and South Atlantic

Administered By: Gulf of Mexico OCS Region

Title: Seismic Survey Mitigation Measures and Marine Mammal
                         Observer Reports

BOEM Information Need(s) to be Addressed: The proposed study would compile
and evaluate mitigation observation data gathered since 2008 following Joint Notice to
Lessees (NTL) No. 2012-G02 or earlier NTL versions and include determinations of
specific mitigation measures effectiveness. This information will be utilized for future
site specific NEPA assessments and programmatic and site specific Endangered Species
Act (ESA) and Marine Mammal Protection Act (MMPA) consultations or coordination
activities. The information will be used to support recommendations for modifications
to mitigation measures and will support future adaptive management of mitigation
requirements.   Information gathered regarding compliance levels of NTL mitigation
will support BOEM's sister agency BSEE with compliance and enforcement operations.
This study would supplement information previously developed in GOMR OCS Study
BOEM 2012-2015 Seismic Survey Mitigation Measures and Marine Mammal Observer
Reports.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2016-2018

Description:
Background: Marine mammals depend on sound to live and perform various life
functions. While marine mammal and sea turtles hearing in not completely understood,
accepted research indicates that noise generated during geological activities can be
heard by and result in behavioral, physical and physiological effects to marine life
(Gordon et al., 2004). To reduce these effects BOEM assigns mitigation measures to
permittees conducting geological activities.

Real time monitoring and reporting are requirements of Joint NTL No. 2012-G02 and
previous NTL versions. Information gathered and submitted by permittees was used to
prepare OCS study BOEM 2012-015. That study compiled and evaluated mitigation
observation data acquired by BOEM during seismic survey operations between 2002
and 2008. The proposed study would compile and evaluate mitigation observation data
gathered since 2008 and include determinations of specific mitigation measures
effectiveness. The study would update and expand BOEM's understanding of mitigation
measure effectiveness and document the ongoing application of mitigations assigned to
reduce noise impacts to marine mammals and sea turtles.

This information will be utilized for future site specific NEPA assessments and
programmatic and site specific ESA and MMPA consultations or coordination activities.
The study results will be used to support recommendations for modifications to
mitigation measures and will support future adaptive management of mitigation

requirements. Information gathered regarding compliance levels of NTL mitigation will support BOEM's sister agency BSEE's compliance and enforcement operations.

<u>Objectives</u>: The objectives of this study are to:

- Summarize and synthesize seismic survey observer reports collected since 2008.
- Include a summary comparison of the results from the new observational data with the previous results from 2002-2008 observational data.
- Based on the results of the analysis of the observational data, make recommendations as to the effectiveness of specific mitigation measures.
- Make recommendations as to possible modifications to mitigation measures or data that could be collected to better evaluate the effectiveness of the current mitigation measures.
- Provide information to BSEE to evaluate compliance levels with Joint NTL No. 2012-G02 and previous versions of the guidelines.

<u>Methods</u>: This study will use the observational data gathered since 2008 to meet monitoring and reporting requirements under Joint NTL No. 2012-G02 and previous NTL versions. The observational data will be compiled, summarized, evaluated for trends and further analyzed using the chi square test, analysis of variance or other statistical techniques that would evaluate if the behavior monitoring data indicate statistical significance differences in species or groups of species behaviors under different seismic source conditions. This study would be closely coordinated with BSEE. Recommendations would be developed as to possible modifications to current mitigation measures, in support of BOEM's commitment to adaptive management and the use of best available science to improve mitigations, if necessary.

Revised Date: January 22, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern
                       Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: USA-Mexico Workshop to Coordinate Future
                       Environmental Studies Related to Ocean Energy
                       Management in the Gulf of Mexico

BOEM Information Need(s) to be Addressed: Coordination with Mexican
scientists and government is a high-priority for BOEM as we actively partner to ensure
safe and responsible development of oil and gas in the GOM. BOEM's environmental
analyses under NEPA will be significantly strengthened through consideration of the
GOM as a single Large Marine Ecosystem (LME), which accounts for environmental
resources and processes on a basin-wide scale, in both U.S. and Mexican waters. BOEM
and Mexico will benefit by exchanging information on current environmental studies
and working together to develop a strategy for collaboration on research topics
identified as high priorities, across a range of disciplinary needs in the biological,
physical/chemical, and social sciences.

Approx. Cost: (in thousands) $250   **Period of Performance:** FY 2016-2017

Description:
Background: The U.S. and Mexico both require an understanding of the current state of
science in the GOM, as well as a strategy for engagement on new research projects to
inform future offshore energy development activities. The BOEM Environmental
Studies Program has most heavily engaged over the last decade with Mexico in the area
of Physical Oceanography. A previous MMS workshop was held in this regard in 2007,
titled "USA-Mexico Workshop on the Deepwater Physical Oceanography of the Gulf of
Mexico." BOEM and Mexico are now strengthening coordination as we work together on
issues related to the High-Level Economic Dialogues, Mexican Energy Reform, the
Trans boundary Hydrocarbon Reservoirs Agreement, and other evolving issues. To fill
related information gaps, moving forward BOEM requires a broader interdisciplinary
understanding of research activities in both U.S. and Mexican waters which span the
biological, physical/chemical, and social sciences.

Objectives: The goal of this study is to convene a workshop of U.S. and Mexican
scientists to discuss the current state of science throughout the Gulf LME, across a range
of disciplines, and to develop recommendations for future binational research
partnerships with relevance to offshore energy activities.

Methods: Co-sponsorship will be sought with relevant Mexican institutions and
agencies. The workshop will consist of invited technical presentations, workgroup
sessions, and a final plenary session. A planning group will be formed to select the
Chairs(s) and finalize the structure of the workshop, with participation from both U.S.
and Mexican scientists. Topics to be addressed include Living Marine Resources and

Habitat, Physical Oceanography, Water and Air Quality, and Social Sciences and Cultural Resources, with a strong interdisciplinary approach encouraged across the workshop to facilitate ecosystem-based management approaches. Topics related to Baseline Measurements, Fates and Effects, and Environmental Monitoring will be discussed, including appropriate observational, laboratory, and modeling methodologies. In addition to potential ocean energy impacts, cumulative impacts such as those related to climate change, fishing, and marine pollution will also be considered. Keynote speakers will be chosen to address selected topics and to stimulate further discussion in workgroups. A final synthesis report will detail major workshop findings. This workshop will provide a roadmap for recommended bi-national coordination on future environmental studies.

Revised Date: April 29, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern
                               Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: A Hydrocarbon Inventory of the Gulf of Mexico

BOEM Information Need(s) to be Addressed: BOEM needs updated,
quantitative information on hydrocarbon inputs to the GOM. This information includes
the sources, forms, and quantitative amounts of hydrocarbon inputs as well as their
fates and effects. Information on both natural and anthropogenic inputs is desired as is
information on accidental, incremental, and routine inputs. Furthermore, BOEM needs
the quantitative amount of hydrocarbon inputs from OCS oil and gas activities
compared to all other sources of hydrocarbon inputs, the contribution each source
makes to any impacts described, and how that relates to the current state of the GOM in
terms of hydrocarbon concentrations in the water and sediments. This information is
required for BOEM's Environmental Impact Statements.

Approx. Cost: (in thousands) $550   **Period of Performance:** FY 2016-2018

Description:
Background: BOEM's Environmental Impact Statements require that BOEM evaluate
the current state of the resources of the GOM, including GOM waters and sediments, as
well as possible inputs to the GOM from oil and gas activities that would result from
BOEM's planned action or possible accidental events during that action as well as the
resulting effects of these discharges on the GOM. Additionally, the cumulative effects of
BOEM's planned action compared to past actions and other natural and man made
activities affecting the GOM must be discussed and quantified to the greatest degree
possible.   One of the important inputs to the GOM that must be considered is the inputs
of hydrocarbons (e.g., oil, gas, grease, and their components). An excellent source for
some of this information has been "Oil in the sea III: inputs, fates, and effects" (National
Research Council, 2003). However, this document is dated especially as post-
Deepwater horizon literature and data become available. A more recent, but limited,
pre- *Deepwater horizon* industry report is published by the American Petroleum
Institute entitled "Analysis of U.S. Oil Spillage" (Etkin, D.S. 2009, API Publication 356).
Thus, an updated inventory of sources, amounts, fates, and effects of hydrocarbons to
the GOM is needed including a summary of the state of the GOM, in terms of
hydrocarbons, based on this updated information. In this synthesis an approach must
be resolved to not only distinguish between possible environmental effects from the
offshore oil and gas industry from other anthropogenic effects such as state oil and gas
development, the fishing industry, onshore industries, oil seeps, river or atmospheric
inputs etc., but also to identify the quantitative contribution that each source makes to
each noted impact.

In addition to a standard report, the products of this effort should include at least one
peer-reviewed paper, a Reference Manager and Endnote readable database of references

used, any electronic copies of references or data used as allowed by copyright law, electronic copies of any calculations conducted and BOEM readable electronic files of any model generated data (if a model is used) along with input files.

<u>Objectives</u>: The objective of the study is essentially a snapshot update to "Oil in the sea" (National Research Council, 2003) that determines the current sources, forms, and quantities of hydrocarbon inputs to the GOM, and quantitatively compares the inputs from OCS oil and gas activities to non-OCS oil and gas activities. Additionally, this study will discuss the fates and effects of the various sources of hydrocarbons to the GOM and identify the contribution that each hydrocarbon source makes to each noted impact. The study should also note any observed data gaps and future research needs.

<u>Methods</u>: This study will include advanced literature searches, data mining, and calculations. The study approach may also include modelling. The study will not fund laboratory analysis, field work, or ship time, but should identify data gaps and/or research needs that may require such efforts in the future. The literature used should include peer reviewed literature, government reports, and raw data that has been released thus far from the Natural Resource Damage Assessment process following the *Deepwater Horizon* explosion and oil spill. All data sources will be required to be documented including full citation of the references used. The investigators will be required to follow quality control procedures and adhere to valid practices for handling metadata. Statistical analysis of the presented results will also be required.

Revised Date: May 1, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico and Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Potential Effects of Oil and Gas Exploration and
Development on Benthic Communities at Selected
Deepwater Sites (>2,000 m) in the Gulf of Mexico

BOEM Information Need(s) to be Addressed: BOEM biologists are required to review exploration and development plans for potential impacts on deepwater benthic communities. NTL 2009-G40, "Deepwater Benthic Communities," gives guidelines for distancing or creating a "zero discharge" area for bottom disturbing activity from these communities (e.g., 2,000 ft muds and cutting radius, 250 ft for all other bottom disturbances). This guidance is based on previous research conducted for wells drilled at depths between 1,033-1,125 m. The application of the "zero-discharge" mitigation allows for drilling closer to deepwater benthic communities than permitted in typical operations because the mitigation only allows cuttings to be released at the seafloor directly from the wellbore, prior to the installation of the riser to the drill rig. Currently, there is no established minimum distance for drilling close to the communities, when "zero-discharge" mitigation is being used. This new study would specifically address development in depths greater than 2,000 m and inform management decisions regarding avoidance and mitigation measures required to conserve sensitive biological resources.

Approx. Cost: (in thousands) $2,000   **Period of Performance:** FY 2016-2020

Description:
Background: Drilling activities in deepwater of the northern GOM have increased as new and improved technologies have provided greater access to deepwater reserves. However, few studies have investigated drilling impacts to deepwater benthic communities in water depths >2,000 m. This proposed study would provide an update to the MMS-funded CSA 2006 study (OCS Study MMS 2006-044) as well as new data applicable to conservation of deepwater biological resources. Findings from this study would directly inform BOEM environmental analyses and aid in effective policy development. The prior study included sites in water depths ranging from 1,033-1,125 m (CSA 2006). Bathymetry, side-scan sonar, sub-bottom profiling, and sediment chemistry and tissue samples from resident fauna were used to develop a fingerprint for each site analyzed. Sediment profile imaging and seafloor photographs helped to characterize pre-development site-specific habitats.

The 2,000-ft. separation distance for muds and cuttings from deepwater benthic communities was derived from the CSA (2006) data showing the majority of the muds and cuttings released from the rigs at the sea surface reached the seafloor within 1,500 ft. of the well sites studied. An additional 500 ft. buffer was added in BOEM regulations to allow the operator leeway to move the well site up to 500 ft. in any direction after APD approval. The 2,000-ft. separation distance is based on sediment dispersion data at

depths less than 1,125 m and it is possible that drilling operations in deeper water may result in a more expansive radius of cuttings on the seafloor.

Conditions of approval to drill, such as the "zero-discharge" mitigation, may also alter the cutting deposits on the sea floor. The initial stage for drilling a well, or well jetting, results in accumulations being spilled over and deposited onto the seafloor as they exit the drill hole. Jetting occurs prior to the riser installation and was found to have seafloor deposits dispersed within 100 m (328 ft) of well sites, much smaller than those created from sea surface released cuttings. Due to the relatively small cuttings radius that occurs during the jetting process, the "zero-discharge" mitigation allows the operator to drill closer than 2,000 ft. from a deepwater benthic community because the mitigation only allows muds and cuttings to be deposited on the seafloor and not discharged at the sea surface after the riser is installed. However, new data is required to measure the actual footprint of released drilling muds and cuttings in water depths >2,000m, where data has not previously been collected.

Objectives: The main objective of this study is to assess the potential effects of drilling in water depths >2,000 m on deepwater benthic communities by documenting: 1) drilling mud and cuttings accumulations; 2) physical modification/disturbance of the seabed due to drilling activities; 3) debris accumulations; and 4) effects on benthic organisms.

Methods: Selected well sites will be surveyed and characterized (e.g.; sediment chemistry, bathymetry, biology, etc.) prior to development. Drilling mud and cutting accumulations will be measured out to 2.5 cm (1 inch) accumulation. Post-development surveys will be used to document physical modification/disturbance of the seabed, accumulation of debris, and visible impacts to benthic communities. Additional analyses of biological samples will be used to determine the extent to which development activities impacted benthic communities. Physical and biological impacts will be measured at a minimum of 2 wellsites. Locations with multiple wells can be selected to maximize cruise efficiency. Side-scan sonar will identify anchor scars, debris, and drill cutting accumulations for completed wells. To determine the extent, thickness, and biological impact drilling discharges on the seafloor prior to the installation of the riser side scan sonar data, sub-bottom profile data, and ROV video will be analyzed. In addition, seafloor current speed and direction will be collected, as well as sediment samples to be tested for drilling fluid tracers (barium and synthetic based drilling fluid).

The study will be conducted at well sites that have the "zero discharge" mitigation applied to their permit. The plans for permits which were granted the "zero discharge" mitigation had a baseline survey of the sensitive habitat and a follow-up ROV video to show the deepwater benthic community was not impacted. This study will expand upon the "zero discharge" mitigation requirements (ROV video of the sensitive habitat to determine if there was impact from the pre-riser discharges) and obtain detailed information on distance and thickness of the pre-riser discharge, influence of currents on dispersal of cuttings, and drilling fluid tracer analysis.

Revised Date: January 23, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Central and Western Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Mapping the Late-Pleistocene Landscapes of the Gulf of Mexico through 3D Seismic Analysis

BOEM Information Need(s) to be Addressed: BOEM is tasked, under Section 110 of the National Historic Preservation Act (NHPA) and Section 101(b)4 of the National Environmental Policy Act (NEPA), with identifying and protecting potential submerged, buried prehistoric archaeological sites on the OCS. Currently areas for avoidance are determined through the analysis of widely-spaced sub-bottom sonar data collected in individual block surveys. An ongoing CMI study offshore Western Louisiana, *Preservation of Paleolandscapes and Identification of Sand Resources for Coastal Restoration*, has evaluated these block survey analyses at a regional level and has determined several issues with this approach, for example: many of the paleovalleys and channels marked for archaeological avoidance are too old to contain Paleoindian sites; gas in estuarine deposits may mask features of potential archaeological interest below them; and because of block size and the extents of typical survey, an interpreter may not realize that a survey is within a larger feature of potential archaeological interest. Additionally, entire paleochannels may be missed at 300 m line spacing. BOEM needs a three-dimensional regional model of buried paleolandforms in which to situate and interpret block and site-specific high-resolution geophysical surveys in order to accurately mitigate and apply avoidance criteria to best protect potential submerged, buried prehistoric archaeological sites. Additionally, methodology for regional modeling and analysis should be in place before surveys begin in advance of oil and gas activity in the GOM EPA and Atlantic Planning Areas.

Approx. Cost: (in thousands) $400   **Period of Performance:** FY 2016-2018

Description:
Background: It is prohibitively expensive to conduct a standard Phase I archaeological survey for the identification of potential submerged, buried prehistoric sites on the OCS; therefore, it is BOEM's policy to avoid and preserve any buried paleolandform that likely dates to the Late-Pleistocene/Early Holocene. Because of this methodology, no buried prehistoric sites have been definitively identified on the OCS in the Western and Central GOM. In 2005, Geologists and geophysicists at the University of Birmingham developed a methodology for analyzing preexisting 3D seismic survey data collected by the oil and gas industry to investigate submerged, buried paleofeatures and create a regional model over a large area. This methodology was successfully applied to a region in the Southern North Sea known as Doggerland, an area in which trawlers regularly recover Mesolithic artifacts. Similar 3D seismic data are available for the Western and Central GOM, and similar sea level rise and resulting geomorphological processes of terrestrial to marine transition means that the methodology applied to Doggerland can be reproduced in the GOM.

Objectives: The primary objective of this study is to replicate the Doggerland 3D seismic analysis project in the Western and/or Central GOM using existing industry-produced seismic datasets to create a regional model with which to evaluate high-resolution geophysical block survey data in order to accurately identify specific areas for avoidance of potential buried prehistoric archaeological sites, thereby supporting BOEM's cultural resource preservation responsibilities under NHPA and NEPA. Project goals include:

- To create maps of the Wisconsinan geological sequence at a regional scale;

- To use "voxel" (cubic binning) rendering to map the 3D architecture of the Late-Pleistocene/Early Holocene system;

- To compare the Late Pleistocene/Early Holocene topographic data with available core data to ground-truth and calibrate results;

- To create a model of survival potential for environmental deposits and prehistoric archaeological sites;

- To provide paleocoastline data which may be used to develop and calibrate sea level and paleobathymetry models.

Methods: BOEM is provided processed 3D seismic data from commercial seismic survey companies that receive permits to survey from BOEM in the GOM. As with the Doggerland project, it is likely that the survey companies would be amenable to donating 3D seismic data to BOEM for scientific, non-commercial purposes. The first two years of the study will involve evaluation and selection of the seismic data (~40-60 blocks) and its analysis and modeling. An optional third year to expand the spatial area of study may be exercised if the initial analysis proves successful. The methodology of this study will follow that of the Doggerland project incorporating modifications suggested as part of the outcome of that project. The approach includes:

1.   Map regionally significant reflectors using the regional 3D seismic dataset;

2.   Interpret these surfaces using artificial illumination and horizon attributes such as amplitude and dip to identify morphological features and developmental chronology;

3.   Generate seismic attributes for the regional 3D seismic dataset;

4.   Sequentially timeslice these attribute volumes (e.g. amplitude, coherence, RMS amplitude) and to employ opacity rendering techniques to identify morphological features and the developmental chronology;

5.   Integrate the above to develop a first order geomorphic model;

6.   Use existing high-res 2D seismic data and shallow borehole data to refine the geomorphic model, resolve interpretational and chronological ambiguities, and to provide paleoenvironmental data;

7.   Generate CAD models that can be imported into a GIS for map production and spatial analysis.

8.   Develop data type, collection, and analysis recommendations for the improvement, enhancement, and expansion of this research.

Revised Date: April 3, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s): Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Interdisciplinary Research at the Site of Three 19th Century Deepwater Shipwrecks: the Monterrey Shipwrecks

BOEM Information Need(s) to be Addressed: BOEM and BSEE are required under the National Historic Preservation Act (54 U.S.C. 306102[b][3]) to fully consider the preservation of historic property potentially affected by agency actions. Information obtained will assist BOEM and BSEE to comply with Standard 2 of the Secretary of Interior's Standards for Federal Agency Historic Preservation Programs, which directs federal agencies to provide for timely identification and evaluation of historic properties subject to effect by agency actions. In addition, BOEM scientists seek to understand how random, but regular anthropogenic inputs onto the deep seafloor are rendered bioavailable and subsequently colonized by benthic fauna in order to conduct environmental assessments required by NEPA. Very little research has been done in the GOM to investigate the role of historic shipwrecks in benthic community development, evolution, and senescence.

Approx. Cost: (in thousands) $875   **Period of Performance:** FY 2016-2017

Description:
Background: In March and April of 2012, BOEM and BSEE participated in a scheduled cruise of the research ship *Okeanos Explorer* that resulted in the discovery of the copper-sheathed remains of a wooden-hulled sailing ship with an artifact assemblage comprised of anchors, cannons, glass bottles, ceramics, navigation instruments, and flintlock muskets that has been initially dated between 1800 and 1840.

In July 2013, BOEM and BSEE participated in a privately-funded partnership that collected 60 diagnostic artifacts and three biological specimens for study and analysis, mapped the site to the centimeter level, and collected high-definition video for both archaeological and biological analyses. Wood samples were deployed for continuing site preservation analysis and sediment samples were acquired for geochemical and biological characterization. Two additional sonar targets reported by Shell were investigated nearby, resulting in the discovery of two additional shipwrecks. The three shipwrecks, all apparently sunk during the same time in the 19th century, have been designated Monterrey A, B, and C after the Shell Oil prospect in which they were discovered.

Objectives: The primary objective of the study is to thoroughly document the present condition of the visible remains of Monterrey A, B and C before any BOEM-permitted oil and gas activity occurs in the area and to determine their historical significance and relationship to the Monterrey shipwrecks assemblage. A second major objective of the study would be to involve and engage the public in the importance and excitement of scientific discovery, and to communicate BOEM and BSEE's role in historic

preservation, environmental protection and the stewardship of offshore resources through extensive web broadcasts and social media. A third objective is to complete the investigation of Monterrey A begun in 2013.

The biological objectives of this study build upon and are informed by the results of the 2012 investigation and will seek to: determine local controls on growth and replacement rates of vestimentiferan tubeworms on the shipwrecks; determine the relationships of the vestimentiferan tubeworms on the shipwrecks with other described populations in the GOM; identify and analyze the effects and potential effects of past and current site formation processes on these shipwrecks associated with vestimentiferan tubeworm activity; determine the spatial and temporal pattern of octocoral recruitment to Monterrey A; and quantify the influence of shipwrecks on benthic infaunal community structure and function ("artificial reef effect").

Methods: To accomplish the archaeological objectives, the investigation will seek: A) to obtain an accurate photogrammetric map of Monterrey B and C, placing the artifacts in their spatial context and accurately mapping the visible remains of the hull as was accomplished with Monterrey A in 2013; B) to recover a limited number of temporally diagnostic artifacts for detailed analysis; C) to recover a limited number of artifacts that will assist in placing the vessel in its cultural and historical context; D) recover and analyze wood samples deployed at Monterrey A in 2013; E) to recover large diagnostic artifacts at Monterrey such as a cannon and the ship's stove; and F) to analyze the collected and visually documented assemblage of artifacts to understand the role of the vessels in the global economy and international relations. Techniques successfully applied to the study of Monterrey A will be replicated during this investigation.

Biological objectives will be accomplished by: A) collecting samples of vestimentiferan tubeworms as deemed appropriate from different locations within each vessel; B) collecting samples of bacterial matting on each shipwreck; C) collecting replicate sediment push cores at specific locations in proximity to the vessel (building upon and expanding the analyses conducted at Monterrey A in 2012); D) laboratory identification of tubeworm specimens and tube remains including the creation of a genetics-based taxonomy; E) laboratory identification of bacterial matting; F) collecting 3-5 whole colonies of octocorals from Monterrey A; and conducting Radio-isotope age analysis of each octocoral sample.

BOEM anticipates continuing the partnership of public and private organizations formed in 2013, including the Meadows Center for Water and the Environment at Texas State University, to leverage private funding to cover conservation and curation costs for recovered artifacts and long-time storage of recovered octocoral specimens for future research. Other agencies including NOAA's Office of Exploration and Research (OER) and Office of National Marine Sanctuaries, the Texas Historical Commission, and BSEE are expected to contribute expertise and personnel. OER is expected to provide the necessary ship and ROV or provide it at a reduced cost.

Revised Date: April 23, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern Gulf of Mexico

Administered By: Gulf of Mexico

Title: A Profiling-Buoy Based Observing System for the Deep Gulf of Mexico

BOEM Information Need(s) to be Addressed: The observations from these buoys will help conduct environmental impact assessments, extend the climatology of bio-optical and oxygen in the GOM's deep waters, and contribute to the establishment of an ocean observing system for the basin.

Approx. Cost: (in thousands) $2,000   **Period of Performance:** FY 2017-2022

Description:
Background: The post-Macondo oceanographic community of the GOM has shifted its focus from process-oriented science to near real-time observing systems. The idea behind the change is the belief that availability of oceanic observations will make response to oil spill events more effective but still help increase oceanographic understanding. BOEM's Environmental Studies Program responded to this shift by placing more emphasis in monitoring centric studies. Because of the areal extent and bathymetric range of the basin, the diversity of information needs and geographic concerns, creating a single unified observing system with available resources seems out of reach. However, BOEM studies and experiences with different observing platforms suggest that a reasonable and affordable observing system of deep waters is using profiling buoys equipped with CTD systems and bio-optical and oxygen sensors reporting in near real time. Such data benefits BOEM, Academic, Federal Government scientists and other stake holders.

Objectives: To expand the CTD, bio-optic, and oxygen profile climatology of the upper 1,500 m layer of the GOM's deep waters and produced a statistical summary of these characteristics.

Methods This study will be conducted using 14 drifting profiling buoys collecting continuous profiles of the upper 1,500 m (7 CDT/bio-optic & 7 CTD/oxygen) released in the deep waters (US and Mexican territories) of the Gulf of Mexico for 4 years. Observations will be distributed in near real-time through an existing data distribution center, e.g., NDBC. The amassed database will be subject to QA/QC procedures and analyzed using simple statistical techniques.

Revised Date: April 27, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Archaeological Investigations of the *C.P. Baker* Shipwreck
Site

BOEM Information Need(s) to be Addressed: BOEM has a responsibility under Sections 106 and 110 of the National Historic Preservation Act (NHPA) to identify and assess potential cultural or historic resources that may be impacted by agency permitted activities. This responsibility includes assessing the eligibility of these resources for listing in the National Register of Historic Places (NRHP) and to nominate those resources that are determined eligible.

Approx. Cost: (in thousands) $90   **Period of Performance:** FY 2017-2018

Description:
Background: On 30 June 1964, the drilling rig *C.P. Baker* was in operation offshore Louisiana when it exploded and sank after drilling into a shallow gas pocket. The accident resulted in the deaths of 21 of the rig's 43 crew members, plus an additional person from another vessel. Preliminary archival research indicates that this incident represents the first rig blowout in the history of the U.S. offshore oil industry and also may be historically significant for other reasons. The resulting Coast Guard accident investigation recommended significant changes to offshore drilling safety regulations, including blowout prevention, fire and water containment, and emergency response protocols. The *C.P. Baker* accident reportedly also led directly to the development of the totally enclosed and motorized survival craft that are still in use on offshore rigs today. Finally, *C.P. Baker* itself is an architecturally unique example of the evolution of offshore drilling rig technology. Built in 1962, it was actually constructed from two U.S. Navy YF-type (covered lighter) hulls that were themselves built in 1945. The catamaran-style construction of the two hulls used for *C.P. Baker* was the first of its kind and is also an archaeological example of the adaptive use of vessels that were originally constructed and employed for other purposes. Taking into account *C.P. Baker*'s age, construction characteristics, and role in the evolution of offshore drilling technology and safety, there is a high likelihood that it is eligible for listing in the NRHP.

The remains of *C.P. Baker* were first identified during a lease block survey for oil and gas development in 1979, though no coordinates or imagery were provided in that report. A 2013 archaeological remote-sensing survey, which was requested by BOEM in association with a platform removal application, identified the wreck in approximately 180 feet of water, with significant structural remains extant. This depth is beyond the range of BOEM diver training, but is well within the operational capabilities of archaeologists with NOAA's National Marine Sanctuaries. This study proposes a partnership with NOAA to conduct remote-sensing and diver investigations of the wreck site in order to assess its NRHP eligibility. NOAA's Maritime Heritage Program has indicated their support of this project and willingness to provide divers, dive support

equipment, and funding for the writing and publication of a collaborative report. NOAA's Maritime Heritage Program is also in the process of creating a Maritime Cultural Landscape overview of the ocean energy industry in the GOM and has informally discussed BOEM assistance with that effort. The planned overview will be a synthesis of the spatial and temporal expansion of the landscape (lease blocks, survey areas, well locations progressing deeper and further offshore, etc.), as well as communities and infrastructure associated with the industry. NOAA's landscape study will also include archaeological sites associated with oil and gas exploration, of which *C.P. Baker* would be a prime example.

Objectives: The primary objective of this study is to conduct an investigation of the wreck of *C.P. Baker* for purposes of assessing its NRHP eligibility.

A secondary objective is to produce public outreach materials that highlight the historical significance of *C.P. Baker,* BOEM and NOAA's collaboration on this project, and each agency's role in the stewardship of maritime heritage and cultural resources in the GOM.

Methods: Field methods will include high resolution remote-sensing survey followed by diver investigation. NOAA staff will serve as the lead investigative divers; BOEM will conduct the remote-sensing operations and supply shallow water dive support and other logistical support. Both agencies will collaborate on a detailed project report concerning the history of the vessel, the aftermath of its sinking, and its significance in the development of offshore oil drilling activities. Furthermore, a 1965 Marine Board of Investigation report on the incident includes the names of the deceased, their nearest relatives, and the names of non-fatally injured crewmen. This information may be leveraged to add an oral history component to the report, as told by the survivors and/or the descendants of the deceased.

The two agencies will also prepare thorough documentation of *C.P. Baker*'s archaeological remains, including a detailed site map, assessment of its structural integrity, state of preservation, and photo/video documentation. If the site is determined to be eligible, BOEM will prepare and submit National Register nomination forms to the National Park Service for consideration. Divers with the University of North Carolina Coastal Studies Institute's Department of Education, Outreach & Communication (under an existing Indefinite Delivery/Indefinite Quantity contract with NOAA's Monitor National Marine Sanctuary) will collect underwater photo/video imagery, including postproduction of each for report documentation and an educational video for public outreach purposes.

Revised Date: June 1, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Assessing Temporal and Spatial Variability in Community and Parish-Level Responses to Oil Spills and Other Events in Coastal Louisiana

BOEM Information Need(s) to be Addressed: This study addresses three information needs. First is the question of the cumulative socioeconomic effects of OCS activities in the GOMR. The Council on Environmental Quality (CEQ) has issued guidance for considering cumulative effects of particular actions on human communities under the NEPA. According to CEQ, a cumulative analysis must take into account those activities that occur prior to the initiation of any proposed action as well as those that occur after the proposed action is completed. Such guidance has proven particularly difficult to implement in the GOMR given the scale and complexity of the OCS-related industry, which includes a diverse array of upstream and downstream support industries and infrastructure. A determination of the cumulative effects of OCS activities must also account for distinctive variations in the physical, economic, and social geography of the region, as well as historical trends in population migration, to effectively determine the influence of the industry on human communities. Coastal and near-coastal Louisiana is the core area for the socioeconomic consequences of OCS development. This research effort will establish, for this core area, a broad range of socioeconomic trends and their interactions as envisioned by CEQ guidance. In so doing, it will develop a methodology that could be applied across the coast. Second, by addressing cumulative effects, this study will also update Gulf information used to support GOMR baseline socioeconomic assessments. Third, the analysis of oil spill impacts, in particular the *Deepwater Horizon* oil spill, will support GOMR oil spill and "worst case" assessments.

Approx. Cost: (in thousands) $550   **Period of Performance:** FY 2017-2019

Description:
Background: Social change is often the result of constant, incremental adjustments to technological, societal, economic, and environmental stressors, but it often happens rapidly after man-made (e.g., oil spills) and natural (e.g., hurricanes, floods) shocks. The general theories relating to human adaptation to disruptive events suggest that single-factor explanations of human responses tend to exaggerate existing social-economic trends, and that the analysis of multiple, combined factors, is necessary to explain social responses. Such complexity is a major finding of the BOEM 2014 socioeconomic study of the *Deepwater Horizon* oil spill (Austin et al. 2014a, 2014b). Even when quantitative analysis finds similar patterns in the data for several communities or finds that similar communities have been able to recover from the same exogenous shock, this quantitative analysis does not necessarily show that the same processes are causing the same observed outcomes. More than one process can create the same pattern just as

multiple interacting processes can do the same. Further, spurious relationships with no causative explanation may exist between an observed pattern and various unrelated processes. Thus, one observation is often wrong; a simultaneous analysis of multiple sources is more empirically grounded.

Objectives: The overarching objective is to assess cumulative and acute socioeconomic impacts of events and trends on Louisiana's coastal and near coastal communities and parishes. To accomplish this, the following objectives will be addressed:

- Develop an enhanced understanding of the socioeconomic effects of major disruptive events (e.g., Deepwater Horizon oil spill, hurricanes, floods and droughts), in the short term (i.e., immediate and near term) and in the long term, on communities and parishes.

- Understand the predictive utility of a selected set of socioeconomic and environmental indicators to identify change at varying spatial and temporal scales

- Gain a better understanding of the spatial and temporal trends that characterize the cumulative socioeconomic impacts of the OCS industry

Methods: The study will address socioeconomic changes in 39 coastal shoreline and coastal watershed Louisiana parishes (as identified by NOAA) and the communities contained within these parishes, from 1940-2015, emphasizing the period from 1970 and beyond because of the availability of high quality quantitative and qualitative data for this time. As noted, a multi-method analysis is necessary to provide causative explanations for observed patterns in the data. The proposed approach can be likened to a police investigation. The research team consists of three groups: secondary data collection and analysis (forensics), field data collection and analysis (detectives), and oversight (police chief). BOEM serves in the last capacity since no study effort can follow all possible leads. The research team will collaboratively conduct an extensive literature review within the first year and utilize a Sci-TEK analysis framework to synthesize the historical data and field data within a GIS environment during the second year. The third year is for writing and report review.

Geo-statistical data analysis will identify temporal and spatial clusters of socioeconomic change and will build on an already assembled wide range of socioeconomic (e.g., demographic, social, health, economic, physical/infrastructural) and environmental (e.g., oil spills, floods, droughts, land loss) data that characterize coastal and near coastal communities and parishes from 1940 t0 2010. Additional data will be collected from a variety of sources, such as the U.S. Census of Population and Housing, the U.S. Census of Agriculture, NOAA Regional Climate Centers weather records, and the U.S. Coast Guard National Response Center oil spill records. Additional data on the development of oil and gas infrastructure in coastal Louisiana, will be collected through permit records kept by the U.S. Environmental Protection Agency, state permitting agencies, and archival records, as well as reports located in government repositories and state archives.

Additional data analysis will look at the interactive effects of multiple events and individual events within the context of preexisting trends to avoid overstating the effects of single events on observed social changes. The investigators will use a geo-statistical approach in GIS and will employ both linear and non-linear data analyses that exist over time and space. Primary data collected from field investigations will be used to ground truth the results of the geo-statistical analysis.

The primary data collected and analyzed by the field scientists will also provide context and direction for the overall study. For example, data from field research will inform the development of hypotheses early in the study. As the research progresses the field analysis will provide 1) general information necessary to interpret data (e.g., supplementing published community information); 2) additional detail on subjects identified by the secondary data analysis; and 3) possibly important subjects not identified by data analysis. For example the group will work with community partners, members of populations under discussion (e.g., shrimpers), and/or local experts (e.g., local unofficial historians) to identify additional information and confirm findings. Qualitative data gathered will also be used to modify and weight the quantitative data models.

In addition to producing a final report, GIS database, and maps, the study deliverables will culminate in a public display, hopefully permanent, in a museum, that includes visual exhibits of the changes in land use and social use over the last several decades.

Revised Date: May 8, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Assessment of the OCS Leasing Program's Demographic Effects on the Gulf of Mexico Region

BOEM Information Need(s) to be Addressed: BOEM needs support for baseline, impact and cumulative impact assessments for the Gulf's newly restructured Economic Impact Areas that form the framework for socioeconomic NEPA analyses. This study will address and focus on demographic change broadly defined at the state and regional/local levels. Regional-level analysis of relationships among OCS activities, labor demand, and demographic change and stability, differences in relationships among regions and over time and space, and factors generating these differences will support the region's ongoing need for a more developed demographic assessment of the consequences of the OCS program and OCS activities at a more regionalized level. This research will also benefit the BOEM estimates of sale-driven employment and population impacts. Currently these estimates are based on a function of the impact model, MAG-PLAN but, since the OCS industry is experiencing a declining labor demand overall, a more direct measure of demand would be more appropriate.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2017-2020

Description:
Background: The petroleum industry has played a major role in the Gulf for over one hundred years, the offshore industry for over sixty. During this time, the offshore industry and associated support sectors have become a large and well integrated part of the Gulf's economy. Projects that result from OCS lease sales are familiar, local labor is poised to meet the demand, and each project blends into the next. These effects are from the routine operations of varied oil-related enterprises rather than from the concentrated activities of the construction trades. The relationships between "new" OCS labor demand, new vs. continuing jobs, new hires vs. employee retention, and in-migration vs. population retention remain outstanding questions in characterizing and assessing demographic change in the GOMR. The petroleum industry has affected Gulf Region demographics directly and indirectly as a catalyst for other changes. However, while important and long-lived, the demographic consequences of the OCS leasing program do not fit the customary social impact assessment (SIA) emphasis on new actions, new labor demands, and new people because of the Region's large, in-place onshore petroleum industry and its associated experienced labor force. In this situation, the demographic outcomes of the industry are consequential – probably more so in the long run than the booms and busts normally analyzed – but in this context these outcomes are also complex and difficult to assess because any ties between the new activities and labor demand generated by OCS lease sales and demographic impacts do not resemble the classic "boom and bust" pattern. The analysis of demographic effects is

important to social impact assessment, leading to issues of growth and decline, benefits and burdens, social change and conflict.

<u>Objectives</u>: The objective of the study is to better understand relationships between the OCS lease sale program, labor demand, and demography at the GOMR, state, and regional or local levels. For example, how have the demographic consequences of the OCS Leasing Program affected the characteristics of the Region's labor force and regional population shifts? What are the characteristics of people and their families that move in to the area as a result of new labor demand? How many "new jobs" due to an OCS lease sale are actually new as opposed to providing support for current jobs through new contracts? How do various sectors of the OCS industry affect demographic outcomes? How are they related to regional growth in general?

<u>Methods</u>: For this analysis, demographics is defined broadly to include population size (e.g., growth, decline), structure (e.g., age, sex), dynamics (e.g., fertility, mortality, morbidity), racial/ethnic composition, household structure (e.g., size, composition), migration and commuting (e.g., magnitude, characteristics), and such other population characteristics as health, education, poverty, and employment status. The overall objective of this study is an improved understanding of the demographic consequences of the OCS program. Most pressing are contemporary relationships between OCS activities and identifiable demographic consequences. For social impact assessment, the question of sale-level labor demand, new vs. continuing employment, and in-migration has proven particularly difficult to address, but, in general, the demographic implications of the OCS industry have proven very difficult to address given that the OCS industry is only a piece of a larger petroleum industry that industry is an integral part of the Gulf's economy and society, that is spread everywhere, and its various parts respond differently to changes in the economy, and its labor demands are cofounded by factors such as long distance commuting and the use of guest workers. In response, the methodological framework for this study profile follows a hierarchical approach. At the top are questions related to social impact assessment—what can reasonably be concluded about the contemporary consequences of OCS sales and the program. In the middle are questions of cumulative consequences—how is the OCS and other factors driving demographic change in the in the GOMR. At the bottom is the historical context—how has all this changed since 1950 (or pick your date). More effort goes into the top than the bottom, but the successful Proposal will present a set of research questions and methodologies aimed at a coherent view of demographic consequences over space and time. A Quality Review Board will be established to provide BOEM with demographic expertise in overseeing study progress and reviewing its results.

Revised Date: May 7, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, and
Eastern Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Cumulative Impacts of Human Activity on Coastal and
Marine Ecosystems of the Gulf of Mexico

BOEM Information Need(s) to be Addressed: BOEM is required to estimate the contribution to cumulative environmental impacts proposed OCS activities may produce, and estimate the contribution other human-derived factors have produced. Such analysis requires spatial data for the identified activities, impact-producing factors, and resources potentially affected. In addition, the magnitude of impact attributable to the proposed activity and implications must be considered. However, these analyses are taken out of context due to the vast differences in data richness, stressors and baseline condition of the numerous resources analyzed. A robust qualitative analysis across a full range of biological, physical and cultural resources could provide the basis for comparing relative conditions and vulnerability, and provide stakeholders with a common foundation for putting into perspective the individual resource cumulative impact analyses. Furthermore, such a comparison would help analysts describe the relative condition of the GOM and identify the contributions attributable to proposed activities, as required by the NEPA process. Qualitative analyses have been performed for environments similar to the GOM (e.g., Mediterranean, Black, North, and Baltic Seas) and are an accepted standard for producing analyses of ecosystems considered too large to be analyzed in detail. This qualitative review would provide BOEM information directly applicable to the GOM cumulative analyses.

Approx. Cost: (in thousands) $125   **Period of Performance:** FY 2017-2019

Description:
Background: Managing OCS oil and gas, marine minerals, and renewable energy development in an environmentally responsible manner requires informed decision-making. Stakeholders rely on BOEM to provide the analyses necessary to evaluate a range of alternatives and the potential impacts of each alternative, as well as the contribution to cumulative impacts. However, ecosystems within the GOM experience a wide range of human-induced stressors in different combinations and with varying frequency, duration and intensity, including those not related to OCS activities. The result is a situation more complex than may be reasonably evaluated for the entire region. A full suite of drivers and effects is not readily available and, while a comprehensive quantitative description of the baseline and analysis of cumulative impacts to GOM is not possible, it would be feasible to identify and obtain data for a subset of major contributing activities and impact-producing factors for sensitive GOM resources. Determination of cause-and-effect relationships between stressors and ecosystems and other resources in this region is possible through robust qualitative analyses. The resulting information would support the NEPA process and consultative

processes by identifying particular resources and combinations of stressors that may require additional in-depth quantitative analysis.

This iterative approach is proposed to meet the expectations described by NEPA and CEQ's regulations. Identification of resources impacted or potentially impacted by programmatic activities is a necessary precursor to finer-scale analyses of OCS impact-producing factors.

Objectives: The objective of this study is to complete a qualitative analysis of the cumulative impacts to selected biological, physical, and cultural resources resulting from OCS oil and gas development and other human activities in the GOM.

Methods: A preliminary workshop will be held to bound the project. Representative resources (e.g., habitats/ecosystems, air quality, cultural resources) will be selected, drivers of impacts will be identified and screened, and available data sets, regional and global experts, and potential time scales identified. The researchers shall compile spatial data for the selected resources or proxies and anthropogenic stressors affecting these resources in the GOM. These data will be converted to accommodate comparisons across the entire region and analyzed. Regional and global experts on coastal and marine resources will be surveyed to estimate resource vulnerability to individual and combined stressors. The current level of cumulative impacts to resources within the region will be assessed. Maps of the resources, cumulative impacts, and drivers must be produced and made available for use within the BOEM selected geographic information system. The format of final analyses must be readily comparable to analyses of other regions' coastal and marine ecosystems.

Revised Date: December 15, 2014

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   National

Administered By: Gulf of Mexico OCS Region

Title: Evaluation of Commercial Unmanned Aircraft System (UAS) Use in Support of Mitigation Requirements Within the Gulf of Mexico.

BOEM Information Need(s) to be Addressed: Mitigation efforts within the GOM exist in all BOEM programs to lessen impacts on natural resources while supporting national energy and marine mineral program needs. Mitigation measures may be implemented to reduce overall impacts to the natural environment, monitor project activities, or to protect critically endangered and protected species, such as marine mammals and sea turtles. These mitigations are found throughout BOEM consultation and NEPA documentation. However, mitigations can add differing degrees of elevated cost, human error, environmental harm, and safety risk to the industry and pose the threat of activity shutdown when the requirements are unable to be maintained. Interest in maximizing UAS as a viable alternative to satisfy or improve certain mitigation requirements will continue to expand as applications for the technology develop. While other BOEM studies are focusing on the scientific pre-lease functionality of UAS in regards to monitoring of marine mammals, utilization of UAS specifically to improve current GOM post-lease mitigation standards has not been investigated and requires a more fully vetted evaluation of the financial, environmental, safety cost-benefits, and state of current regulations prior to determining the viability of the technology as a regulatory and mitigation resource.

Approx. Cost: (in thousands) $ 200   **Period of Performance:** FY 2017-2019

Description:
Background: While Unmanned Aircraft Systems (UAS) are gaining momentum as a resource to study wildlife populations, such as the ongoing BOEM studies in Alaska, very little has been done to evaluate the viability of effectively incorporating this technology into current standard post-lease regulatory policies and mitigations. Use of Commercial UASs in lieu of more traditional techniques provide a potential avenue to reduce risk to personnel, reduce survey error, minimize environmental noise and pollutant degradation, limit exposure and disturbance to marine life, and reduce overall project cost and duration. UASs are being utilized by industries such as agriculture, construction, mining, and energy to provide critical information and eliminate inefficiencies. Post-lease mitigations for protected species have commonly consisted of Protected Species Observers (PSO) on platforms, vessels, or aircraft visually monitoring species that come within a certain distance of a project location. These distances can range from 50 to more than 2,000 feet. In the case of platform decommissioning, extensive aerial monitoring is required around the site and can result in shutdowns if PSO's cannot reach the site or effectively monitor the site due to equipment or adverse weather. Geological and geophysical (G&G) surveys also require specific distances at which source vessels must be from species of concern prior to beginning or continuing

surveys. Mitigations, unrelated to protected species, which involve areas such as management of safety or navigation may also be improved through utilization of UAS. The Marine Minerals Program, for example, often requires visual observation of floating pipelines transiting sand resources to coastal inland systems and aerial surveys of restoration sites. These mitigations, as well as many others not listed, often result in costly maintenance requirements or shutdowns when circumstance or conditions result in an inability to successfully monitor a site or require prolonged flight times. While there is currently no definitive data, UAS has the potential capability to provide more accurate regulatory information while reducing impacts, such as noise, water, and air pollution, that may be associated with aircraft/helicopters and vessel use in addition to the reduction in health and safety risk.

BSEE also supports new mitigation approaches such as UAS and participated in a 2013 BSEE Strategic Planning Team that investigated possible UAS assistance for monitoring during decommissioning's and seismic surveys. However, trial usage of UAS equipment was not conducted due to several issues related to Federal authorization and Federal Aviation Administration (FAA) requirements.

Objectives:

- Identify current or future mitigations, activities and strategies with the potential for improvement or replacement with utilization of UAS.

- Evaluate the capabilities and constraints of UAS technology including commercially available hardware and the adaptability of available technology as it relates to current mitigation standards in the GOM.

- Assess environmental, financial, socioeconomic, legal and safety ramifications of UAS on industry, BSEE and BOEM as it relates to existing mitigation requirements within the three BOEM energy programs.

- Perform a cost analysis for incremental costs to an operator running an UAS in lieu of current mitigation standards.

Methods: Evaluation and assessment of the technology will be conducted using a comprehensive search and integration of the best available methodologies for research. Data collection will include market and industry research for economic analysis, professional interviews and investigations, and any other means necessary to identify, acquire, review, and annotate all scientific, economic, safety or health, and technological literature (published and unpublished) for the proposed use of technology. BOEM and BSEE will provide documentation on mitigations, legal and cooperative requirements, and activities relevant to the study, such as studies on-going by Alaska Region, to assist in the development of report framework and provide context. Cost-analysis will evaluate the financial, environmental, and safety components of the activity on the federal government and industry. Period of performance is expected to be 24 months, with a deliverable report after 15 months.

Revised Date: May 4, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: GOM Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology & Archaeology II (GOM-SCHEMA II) Project

BOEM Information Need(s) to be Addressed: BOEM, as a Federal permitting agency, is required under the National Historic Preservation Act (NHPA) of 1966, as amended, to consider the potential impacts of its permitted activities on cultural resources before issuing such permits. Prior to the 2010 *Deepwater Horizon* (DWH) spill, limited scientific information was available to adequately inform BOEM of the impacts of an oil spill on submerged cultural resources such as shipwrecks. In addition, the Natural Resource Damage Assessment (NRDA) process and subsequent studies initiated after the spill have not evaluated impacts to submerged cultural resources. To address this information gap, BOEM funded a multidisciplinary study in FY 2013 with other Federal, academic, and private partners to identify potential impacts from the DWH spill on deepwater shipwrecks and their resident biota. This new study intends to continue the previous study and will repeat data collection and analysis of samples from the same shipwreck sites in 2018 (four years after the initial post-spill sampling efforts in 2014), a total of eight years after the spill. By repeating the sampling and analyses at four-year intervals, the study will begin to inform cultural resource managers of the DWH spill impacts over time. Information acquired by continuing the study will allow BOEM to more adequately consider the potential impacts of a spill on cultural resources (comply with NHPA), directly inform BOEM's analysis of an oil spill's cumulative impacts on submerged cultural resources (comply with NEPA), and enable long-term monitoring of these important non-renewable resources.

Approx. Cost: (in thousands) $2,900   **Period of Performance:** FY 2017-2021

Description:
Background: Shipwrecks have been demonstrated in previous studies to serve as artificial reefs in the deepwater environment. These hotspots of biodiversity are randomly distributed and are often the only topographical feature in an otherwise featureless seafloor. Beginning in FY 2013, BOEM funded a three-year multidisciplinary study with other Federal, academic, and private sector partners to examine the impacts of the 2010 DWH oil spill on deepwater shipwrecks and their resident biota in the GOM. The study, named the "GOM Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology & Archaeology (GOM-SCHEMA) project," collected water, sediment, wood, metal, and biological samples as well as video and high-resolution photos from eight (8) deepwater shipwrecks in the GOM. Additionally, 3D laser, 3D sonar, and high-resolution multibeam bathymetric data were collected at select sites to digitally record their current condition and extent of degradation. Lastly, *in situ* monitoring platforms were deployed and recovered to provide insight on the effect of local contamination on hull material degradation and bio-fouling recruitment patterns (biofilms). The study sites included wooden-hulled and metal-hulled shipwrecks at varying proximity to the

Macondo wellhead as well as control sites located outside of the spill-impacted area. The GOM-SCHEMA I study found evidence of a significant sedimentation event after the spill that modified the local environment at sites nearest the spill origin. Microbiome composition showed reduced microbial diversity and community functionality, which indicates that the effects of the spill persisted after four years, and may have long term impacts on site preservation. In addition, preliminary analyses indicate that metal corrosion and biofilms are negatively affected by exposure to oil and dispersant. The GOM-SCHEMA II project intends to return to the selected shipwrecks from the first study to repeat data collection, sampling, and experimental approaches after another four years have passed. Additional shipwrecks may be added to the study.

Objectives: This study will continue efforts to evaluate long-term impacts of the 2010 spill and chemical dispersants on submerged cultural resources. The totality of the data will inform BOEM about the rate of changes occurring at these sites, especially where wood degradation and metal corrosion are concerned, and the level of preservation. This information will assist BOEM with long-term monitoring of these deepwater ecosystems.

Methods: This follow-up study will repeat the objectives and tasks of the GOM-SCHEMA I study to comparatively analyze pre-spill data with data collected four years (2014; GOM-SCHEMA I) and eight years (2018; GOM-SCHEMA II) after the spill.

1) Repeat sampling, data collection, and analysis efforts from GOM-SCHEMA I;

2) Assess the current physical, chemical and ecological condition of select wooden-hulled and metal-hulled shipwrecks and their local environment in the GOM within and outside of the spill-impacted area;

3) Conduct a detailed comparative analysis of the environmental, macro and microbiological, and archaeological condition of each selected site with previously collected data;

4) Assess the biota associated with the sites and evaluate temporal changes over time as well as any changes related to the DWH spill; and

5) Obtain a firm understanding of the structure and function of microbial communities and biofilm formation on deepwater shipwrecks.

BOEM will again seek to assemble a broad partnership among Federal, academic, and the private entities and other funding sources which will help to reduce the costs to BOEM. Methods will include: microbial ecology, coral microbiome analysis, bioinformatics, physical and geochemical characterization of sites, corrosion microbiology and morphology analyses, archaeological site assessments, collection of 3D optical and/or acoustic data, high resolution video and photos, updated site plans, and public outreach and education.

Revised Date: May 15, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Hydrocarbon-Degrading Symbionts in Deepwater Corals

BOEM Information Need(s) to be addressed: Recent research indicates deepwater coral communities in the GOM exhibited greater resilience than expected following exposure to hydrocarbons following the DWH oil spill. These findings are not explained by the information obtained during those investigations. However, research on corals in the Arabian Gulf suggests communities of hydrocarbon-degrading bacteria resident in the mucus and tissues of coral could potentially convey some degree of resilience. Discovery and analysis of similar symbionts in deepwater corals of the northern GOM could benefit BOEM and other stakeholders interested in understanding and protecting these resources. NEPA analyses and current avoidance mitigations are based upon observed sedimentation patterns and rates associated with OCS oil and gas development. However, scientifically sound resource analyses and protective measures should be based on information developed from studies of all relevant impact-producing factors.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2017-2019

Description:

Background: The 2010 DWH oil spill resulted in a surge of scientific effort focused on evaluating the potential adverse impacts to coastal and marine resources. The increased scrutiny succeeded in highlighting information gaps with the potential to limit BOEM's ability to design and implement effective mitigation measures for the protection of deepwater coral communities. Furthermore, improved information regarding deepwater coral ecology and potential sensitivity to environmental hydrocarbons could greatly increase the accuracy of predictions with respect to the effects of accidental spills on these communities. Deepwater coral communities are associated with hard substrates located in areas frequently targeted for OCS development. These communities are assumed to be susceptible to a variety of potentially impact-producing factors. However, recently published studies documented a highly variable response among coral communities impacted by oil-containing floc, suggesting other factors may be affecting the resiliency or susceptibility of coral communities to adverse effects due to exposure to oil. An unrelated study of corals (*Acropora clathrata* and *Porites compressa*) exposed to natural oil seeps in the Arabian Gulf suggests one potential factor may be symbioses. Hydrocarbon-degrading bacteria of the phylum *Gammaproteobacteria* were found to dominate the communities harbored within these corals' mucus and tissues. The researchers hypothesized the bacterial communities could represent an adaptation to an oil-rich environment and provide host corals with an advantage by degrading hydrocarbons into less toxic compounds. Such an adaptation, if present in deepwater corals of the GOM, could explain some of the resiliency recently observed.

Accurate analyses of resource-specific vulnerabilities to OCS impact-producing factors are necessary for development and implementation of effective mitigations. For years BOEM has led the effort to investigate the ecological boundaries of sensitive deepwater benthic communities. The information developed through these investigations forms the foundation for our deepwater benthic community NEPA analyses and conservation efforts. Evidence of potentially significant differences in susceptibility to impact-producing factors could influence BOEM's policies with respect to OCS activities. The purpose of this research is to identify the presence of hydrocarbon-degrading symbionts in deepwater corals of the GOM and to assess the potential benefit to corals provided by these bacterial communities.

Objectives: The objective of this study is to determine:

1. Whether deepwater corals in the GOM harbor hydrocarbon-degrading bacteria; and

2. Potential advantage conferred to deepwater coral hosts of hydrocarbon-degrading symbionts.

Methods: Mucus and tissue samples from deepwater corals in the GOM will be analyzed for indication of bacterial communities. Sampled hosts will include corals from communities located in areas with both chronic hydrocarbon exposure and with little or no hydrocarbon exposure. Symbionts will be analyzed for genetic sequences indicative of hydrocarbon degrading pathways. A more detailed study can be accomplished using metagenomic analysis to evaluate bacterial biodiversity and potential genes that trigger susceptibility or resistance in corals.

Revised Date: January 8, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern
                       Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Nocturnal Surveys for Migratory Birds and Insects in
                       Association with Lighting at Offshore Oil Production
                       Platforms, Gulf of Mexico

BOEM Information Need(s) to be Addressed: BOEM, through the National
Environmental Policy Act (NEPA), assesses potential environmental impacts of oil and
gas activities on platforms off the coast of Texas, Louisiana, Mississippi, Alabama and
Florida. BOEM also develops and implements means to avoid and minimize potential
adverse impacts associated with those oil and gas activities. The Gulf of Mexico is a
migratory pathway for hundreds of millions of migratory birds and insects. Research
has shown that birds are attracted to artificial lights on offshore structures, including
several species of conservation concern (Hamer et al. 2014, Marquenie et al 2013,
Russell 2005); however, the specific conditions under which attraction events occur in
the GOM have yet to be evaluated. After a review of data gaps or incomplete and/or
unavailable information within BOEM's NEPA documents and after discussions of
BOEM's Avian SME team, this study profile was developed to consider the effects of
lighting from oil and gas activities on bird and insect migration, survival, and mortality.
Using existing facilities, this study would assess how artificial lighting on oil platforms
in the Gulf of Mexico is affecting bird and insect species migrating throughout the
northern GOM. BOEM would use the data generated from this study to answer
knowledge gaps about the factors that positively or negatively influencing bird and
insects migrating over the GOM, how OCS platforms and the associated light influence
migration, survival, and mortality, and ultimately support NEPA analyses and possible
development of practical mitigation measures (e.g., including changes in lighting
intensity and/or color) that could reduce potential impacts while maintaining safe
operations.

Approx. Cost: (in thousands) $2,000   **Period of Performance:** FY 2017-2019

Description:
Background: Offshore oil operations in the GOM are conducted from approximately
2,411 platforms. A number of potential mechanisms for avian attraction to platforms
have been posited including the presence of light, in the form of platform lighting and
flaring (Wiese et al. 2001, Russell 2005). Lights are present on the platforms to
illuminate working and walking areas and make the platforms visible to passing ocean
vessel traffic and aircraft. The attraction of birds to bright lights in the marine
environment, associated light-induced mortality or impairment of birds from collision,
or exhaustion due to nocturnal circulation has been well-documented (Marquenie et al.
2013, Merkel et al. 2011, Russell 2005, Longcore and Rich 2004). Despite this, there is
still some uncertainty about the conditions in which migrating birds become affected by
platform lighting and how it varies from region to region . Based on recent studies in the

Pacific OCS (Hamer et al. 2014) and in the North Sea (Marquenie et al. 2013), platform lighting may proportionally affect migrating birds based on the intensity of the platform lighting and/or the color of the lighting. Hamer et al (2014) suggested that most migrating seabirds in the Pacific Ocean avoid platforms on most occasions during clear nights, and Russell (2005) suggested circulation events seem to be more prevalent on some platforms or under certain weather conditions in the GOM. Studies in the North Sea have suggested that changing lighting on platforms from white, yellow or red to blue or green lighting can reduce attraction events (Marquenie et al. 2013). This corresponds to data collected by Wiltschko and Wiltschko (2014) that suggests that pigeons have difficulty orienting under red and yellow wavelengths. In addition to avian studies, previous studies on lighting in the GOM have suggested that insects may be influenced by platform lighting (Sparks 1986, Keaster et al. 1996, Russell 2005). As a potentially important food resource for migrating birds, insect migration and attraction to platforms and platform lighting should be considered. Further study of the relationship between light intensity and color, insect prevalence, and avian nocturnal migrations have been recommended in the GOM (Hamer et al. 2014 and Russell 2005). Lastly, attributes (geographic origin, age, species, and sex) of individual birds may influence their propensity to suffer mortality on a platform.

An assessment of potential direct and indirect impacts to avian resources from offshore oil and gas activities in the GOM remains one of the biggest knowledge gaps in the current NEPA assessment. Data obtained from this study will be instrumental in addressing major information gaps regarding the interaction between birds and insects and lighted platforms and could result in possible mitigations or stipulations specific to avian or insect resources in the offshore environment. Detailed information on the potentially affected resources will be required for appropriate analysis and mitigation of any of the activities or impact producing factors. BOEM has responsibilities for protection and conservation of avian resources under NEPA, Migratory Bird Protection Act, and the Memorandum of Understanding between the MMS (now BOEM) and the Fish and Wildlife Service (USDOI, 2009) signed on 4 June 2009. An example of a region specific, practical mitigation that BOEM recently developed and is currently implementing requires lessees in the Chukchi Sea to provide a written statement of the measures they intend to implement that will minimize the radiation of light outward from exploration or delineation drilling structures to minimize the likelihood that birds will strike those structures. Shell has proactively achieved this by substituting white light with green lights.

Objectives: Emphasis will be to fill knowledge gaps identified in recent BOEM reports with three objectives: (1) relate lighting conditions (color and intensity), platform location, insect attraction and prevalence, and weather conditions to the intensity of bird attraction events (2) determine bird/insect attributes (e.g., origin, age, species that may contribute to the likelihood of the bird/insect landing, thriving, or dying on a platform and (3) determine light pollution of platforms in GOM and extrapolate avian mortality estimates based on the lighting color and intensity.

Methods: (1) Nocturnal radar should be used on or near oil and gas platforms to quantify bird-platform interactions during fall and spring migration. If possible, insect

interactions should be simultaneously recorded. If platform consent is achieved, blue or green lights should be installed on a portion of the platforms evaluated. Intensity of the platform lighting will be evaluated using methods below. Insect diversity and abundance will be measured using light traps. Weather conditions and moon phase should be recorded during each radar session. In addition, nocturnal radar should be collected from non-active platforms or barges to determine baseline migration levels. Locations of platforms and baseline readings should be relatively evenly spread throughout the planning areas. (2) Birds and insects that suffer mortality on a platform should be identified to species and evaluated through stable isotope analysis for origin. In addition, any birds carcasses collected will be evaluated for age, body condition, cause of death, and sex. (3) A light emittance survey should be conducted to evaluate relative light intensity at each oil platform on the OCS. Methods should be similar to those developed by the Giant Segmented Mirror Telescope Program Office at the National Optical Astronomy Observatory to measure light intensity using night sky satellite imagery (National Optical Observatory 2009). If a relationship between platform light intensity is found, bird mortality estimates should be extrapolated.

Results will include: (1) identification of the properties of a platform and weather conditions that are highly related to bird and insect attraction to platforms (2) general trends in the migratory pathway and conditions of birds and insects that suffer mortality on a platform and (3) an overall assessment of the positive and/or negative impacts of platform lighting on migratory bird mortality gulf wide to inform implementation of region specific (i.e., Gulf of Mexico related), practical stipulations and/or mitigations.

More specific details regarding methodologies, timing, location, type of surveys, and sample preservation methods will be determined at a later date.

Revised Date: January 9, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Seabird Surveys and Modelling in the Offshore Gulf of Mexico

BOEM Information Need(s) to be Addressed: Additional information is needed on seabird seasonal species composition and total species population sizes in the offshore GOM. The information could be used to determine offshore pelagic targets at risk (seasonally) in OSRA analysis. Right now that type of OSRA analysis is not possible. The baseline information would also be useful for years for assessment of potential or actual impacts of a large future spill like the DWH incident. Also, the information could be used by other agencies for determination of any species of conservation concern, threatened species, or endangered species; that determination would be important in turn for BOEM coastal and marine bird write-ups in BOEM NEPA documents.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2017-2019

Description:
Background: There is almost no baseline information on offshore seabirds from surveying and modelling. After an oil spill, a clear picture of impacts on these birds cannot be estimated without knowing baseline populations of the various offshore (including deepwater pelagic) seabird species. An oil spill can occur in any season, and the composition of offshore seabird species and their population densities vary with season, so at least one survey per season is needed. Pelagic habitat is always changing but modelling using habitat covariates can be used to predict species distributions and abundance based on any future habitat distributions. Many pelagic seabird habitats can be determined using inexpensive remote sensing.

Objectives: At any time in the future, the proposed study will allow use of remote sensing habitat data to produce maps of broad spatial scale biogeographic information on offshore seabird distribution and abundance derived from knowledge of the habitat covariates of seabird communities, species, and populations. In addition to biogeographic information, survey data can be used to estimate the total number of birds of various seabird species for use in calculating total mortality from an offshore oil spill.

Methods: Surveys would be done by inexpensively putting observers on NOAA trawl, marine mammal survey, and/or plankton cruises until at least one survey is completed for each season of the year. More than one survey per season can be conducted if geographic variability makes the data inadequate for determination of results.

Revised Date: January 13, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern
                             Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Social and Economic Impacts of Outer Continental Shelf
                  Activity on Individuals and Families (Update One)

BOEM Information Need(s) to be Addressed: BOEM is seeking ways to
strengthen its monitoring of the OCS program under NEPA. This is an update and
extension of the BOEM study "Social and economic impacts of outer continental shelf
activity on individuals and families" (Austin, et al. 2002), a study that has served as the
primary source for BOEM analyses of local-level socioeconomic conditions and effects
for the last 13 years and has been consistently cited by every Gulf Environmental
Assessment ever since its publication. Monitoring sociocultural and socioeconomic
impacts is recognized by BOEM as an undertaking that must be pursued. This study will
address the urgent need to establish a methodology and system for this monitoring.

Approx. Cost: (in thousands) $700   **Period of Performance:** FY 2017-2019

Description:
Background: The coastal Gulf, its communities, and the OCS industry have gone
through many changes and witnessed great shocks during over the last several years and
as a result, Austin (2002), as the basic source for community-level socioeconomic
baseline and analysis, needs to be updated. Also, as an extension of the original BOEM
study, Update One represents one step in establishing a strong socioeconomic
monitoring system in the Gulf of Mexico Region. Update One will establish the
methodology for sociocultural monitoring, and, as well, begin to address wider Gulf
socioeconomic monitoring questions.

Interim products are designed to facilitate early use of information to support the
development of a socioeconomic monitoring program and to support environmental
assessment.

Objectives: The main objective of this study is to better understand the issues,
approaches, and methodologies relevant to Gulf socioeconomic monitoring. A secondary
objective is to improve socioeconomic assessments and knowledge of the social and
economic impacts of outer continental shelf activity on individuals and families in three
communities.

 Methods: If the past is any measure, one cannot anticipate all the significant factors
will be driving Gulf oil or shaping Gulf family and life 10 or 20 years hence. However,
the basic areas of BOEM local-level socioeconomic concerns are more stable than are
these drivers. For example, Austin (2002) indicates that many oil industry effects on
family community life relate to changing labor demands or conditions of work, what the
industry needs, how schools, family, and individuals respond, etc. BOEM seeks a

monitoring system that compares and contrasts family life effects among communities to assess salient conditions and factors, and compares and contrasts these with earlier ones to monitor changes in industry effects on family life. This backward-facing approach reflects the richness of the available information as well as the unpredictability of its future, and it reflects the NEPA direction to monitor as "taking a second look." The problem is to identify approaches/methods/systems that are sufficiently stable to support comparisons through time and sufficiently flexible to be applicable decades hence. This team will develop monitoring methodology through literature review, meetings and synthesis. Instead of a workshop, the effort will be directed by a by a steering committee which will establish and coordinate smaller specialized work groups as needed to develop the overall methodology.

The study will update the original "Social and economic impacts of outer continental shelf activity on individuals and families" (Austin, et al. 2002) study and will use, similar research methods (e.g., literature review, field-based ethnography, community partnering). The study will include the 2 original and 1 additional study community. This study will provide BOEM with meeting reports, literature syntheses, oral transcripts and final reports.   Future updates will benefit from detailed research notes from this effort. Thus, while not normally a deliverable, to the extent practicable a record of such notes will be delivered that is stripped of personally identifiable information and other inappropriate materials.

Revised Date: May 11, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico, Eastern Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Testing Chang and Oey's (2011) Gulf of Mexico Oscillator Hypothesis: A Field Program

BOEM Information Need(s) to be Addressed: The results of the study should help improve performance of numerical models of GOM circulation that in turn should lead to enhanced spill risk analyses and passive particle dispersal for environmental assessments.

Approx. Cost: (in thousands) $2,500   **Period of Performance:** FY 2017-2021

Description:
Background: Many gaps still remain in our understanding of the GOM circulation. However, some recent advances from one of BOEM's studies were published in peer-reviewed literature (Chang and Oey, 2010a,b; Chang and Oey, 2011). In the latter article, the authors proposed the idea that the Gulf's thermocline oscillates like a low-frequency (time scales of 11 months) see-saw along an east-west line across the GOM in response to the Loop Current intrusions and an east-west mass transport across the 90°W parallel induced by the intrusion and displacement of resident water. Testing this hypothesis is important because it can shed light on the Loop Current intrusion and the GOM adjustment to such energetic events. Any advance on this front will have great repercussions on our understanding of the Gulf circulation and our ability to employ numerical circulation models to forecast the circulation.

Objectives: The goal is to test the Gulf of Mexico Oscillator hypothesis of Chang and Oey (2011) by measuring the thermocline depth and correlating this with the zonal mass transport at 90°W below the thermocline induced by the Loop Current intrusion.

Methods: This study will analyze existing data and other model outputs to find preliminary evidence corroborating the Gulf's oscillatory hypothesis advanced recently in the scientific literature. These results will be employed to adjust the initial experimental design and array to maximized likelihood of success. Also, plans to deploy an array of pressure inverted eco-sounders and other needed instruments consisting of two orthogonal transects should be put forward. The east-west transect will run across the Gulf but will be confined to depths ≥ 2,500 m located initially along ≈ 27°N meridian with sufficient stations (number of stations ≥ 4 by sampling theorem) to resolved the oscillation. The north-south transect will span the Gulf within water depths ≥ 2,500 m at 90°W, again with sufficient stations to compute the transport with an error of ± 0.5 Sv. Because of our interest in low frequency processes, the array will be deployed for at least four oscillation cycles or ~48 months. The final products will include Deep Gulf mass transport information, reports and manuscripts for peer-

reviewed journals. Every effort will be made to leverage this effort with other U.S. and Mexican Agencies interested in this experiment.

Revised Date: May 11, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: The Production and Distribution of Subsistence in Coastal
Gulf of Mexico

BOEM Information Need(s) to be Addressed: This information will support all Gulf socioeconomic assessments (EAs, sale EISs and multi-sale EISs) as it becomes available. This research specifically addresses (a) Section 4-4 of the CEQ NEPA guidelines which focuses particular attention to the issue of subsistence consumption of fish and wildlife and in its importance to minority populations, low-income populations, Indian tribe or subgroup of such populations and, (b) Executive Order 12898 requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects on minorities and low-income populations and communities. NEPA process requires consideration of the extent of social and cultural impacts and of the distribution of impacts to specific communities.

Approx. Cost: (in thousands) $600   **Period of Performance:** FY 2017-2019

Description:
Background: The DWH oil spill proved the importance of subsistence foods to many Gulf coast households. It also showed a lack of basic knowledge concerning Gulf coast subsistence—what it is and who produces and consumes it. Thousands of claims for loss of subsistence filed with the Gulf Coast Claims Facility (GCCG) lacked documentation. While some commercial fishers were eventually paid based on ethnicity and need (MQVN 2010; Hammer 2011), this settlement did not resolve the underlying questions regarding the nature and scope of Gulf subsistence. BOEM shares its subsistence-related policy concerns with its sister agencies the National Marine Fisheries Service and the U.S. National Park Service who are addressing subsistence fisheries as mandated under the Magnuson-Stevens Fisheries Management and Conservation Act (MSFMCA). BOEM intends to work with its sister agencies to address these shared concerns. This BOEM study can stand alone. However, should a recently issued National Marine Fisheries Service, Marine Fisheries Initiative (MARFIN) research proposal for Gulf Coast Subsistence go forward, the BOEM study design will serve to complement and extend the MARFIN research. The team will coordinate with any ongoing MARFIN research.

Objectives: The primary objective is to gain a better understanding of the production and transfer of subsistence goods (e.g., shrimp) from firms (e.g., a shrimp boat) to subsistence consumers (e.g., households, church functions) as well as the variability among producers and transfers. A secondary objective is to understand these behaviors within a wider social context that also includes other types of Gulf subsistence activities and individual attitudes motivating their activities.

<u>Methods</u>: Little is written about Gulf subsistence. Popular literature provides the most information (e.g. Tidwell 2010); one academic work (Gramling et al. 2006) contains species lists. In response to DWH, BOEM and Louisiana State University launched "Coastal Gulf of Mexico Subsistence: An exploratory study"

This study will supplement the scant available published works, gray literature and government reports and data with discussions with experts on Gulf subsistence (such as academics, local historians, and city, parish and state officials including area officials with the Louisiana Department of Wildlife and Fisheries). For comparative purposes, this study will also review and synthase selected literature on subsistence elsewhere in the world.

Social science literature describes subsistence harvest systems as organized by non-market principles of kin and community (cf. Magdanz et al. 2002 for Alaska; Glazier 2009, Impact Assessment, Inc. 2012, NMFS 2014 for elsewhere in U.S. and protectorates). However, the Gulf is an exception and, there, the largest single source of subsistence is shrimp that are removed from commercial catches prior to their potential sale. Thus, unlike the subsistence systems described in the literature, these shrimp become subsistence because of how they are used, not because of how they are produced. Also unlike the subsistence systems described in the literature, the BOEM exploratory research finds that coastal participants define themselves in terms of the activities in which they are participating—they see themselves as shrimpers, recreational hunters, etc., and they attach different meanings, values and traditions to each of these activities.

The major research effort will focus on the shrimping industry, the most significant source of subsistence foods, and the effort will focus on the transfer of harvested shrimp to subsistence users (e.g., households, church functions, etc.). The research team will use ethnographic field techniques, key person discussions, and similar methods to identify the characteristics of firms (boat size, ownership, linkages to docks and markets), crews (kinship, ethnicity, age), harvests (size, difficulties, seasons), recipients (e.g., related household, church organization), and the conditions and considerations (e.g., beliefs, traditions) that influence these transfers. Because this industry is highly variable (e.g. large formally-organized crews, small part-time operators) this effort will be both extensive and comparative. A goal is to establish an understanding of the range of participants (givers and receivers), the range of behaviors, and the range of motivations for them. Also for comparative purposes, the researchers will conduct a similar but less intense effort on a second harvest activity. Finally, the original BOEM and Louisiana State University "Coastal Gulf of Mexico Subsistence: An exploratory study" set the agenda for this one. Some of the information gaps in this earlier report will be addressed by additional literature synthesis and fieldwork.

Revised Date: May 8, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Western Gulf of Mexico, Central Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Tracer Experiments for Atmospheric Dispersion Model

BOEM Information Need(s) to be Addressed: The assessment of the impact of air emissions released from the OCS source on the onshore air quality is needed in the NEPA document, which is required in the Clean Air Act and NAQSDS. Recently, EPA has set more stringent air quality regulations and also currently considers to replacing the EPA air quality model with a newer generation of air quality model. AERMOD model also will be used to replace the BOEM's OCD air quality model. Furthermore, AERMOD model (EPA) was developed for overland applications. For the Gulf of Mexico, the present data sets are poorly representative of how temperature, winds, and mixing height vary vertically over the atmospheric boundary layer and free troposphere. The existing regulatory air quality models   have not been rigorously tested in the marine and coastal environments.

Approx. Cost: (in thousands) $1,900   **Period of Performance:** FY 2017-2018

Description:
Background: BOEM has ongoing studies, which include "Air Quality Modeling in the Gulf of Mexico Region", to investigate the BOEM's exemption levels and the cumulative impact analysis, and "Enhancing the Capability of a New Meteorological Model for Air Quality and Other BOEM Applications in the Gulf of Mexico". A meteorological field program to collect the meteorological and wave data over the water has also been proposed and described previously. The meteorological model is crucial in the success of the accurate prediction of air concentrations. The accurate wind field generated from a meteorological model is needed for the transport of air pollutants and the meteorological data is also needed in the derivation of the dispersion parameters needed for air quality modeling.

Objectives: This study is a major tracer field campaign to obtain independent air concentration dataset for air quality model verification, especially in the coastal areas. The collected data can be used to derive the dispersion parameters needed for dispersion modeling. The information obtained from the meteorological measurements is crucial in understanding the atmospheric process, characterizing the structure of the atmospheric boundary layer, and the derivation of the dispersion parameters needed for air quality modeling.

Specific objectives are to obtain the following information:

- Conduct offshore tracer experiments

- Collect meteorological and dispersion data

- Collect plume fumigation data for coastal dispersion model.

- Conduct plume downwash tracer experiment from an oil platform

- Collect measurement for mixing height.

Methods: The approaches for this study are to conduct field tracer experiments and to set up routine meteorological measurements over the land and overwater for atmospheric dispersion modeling. The tracer experiments will be conducted from a boat and a platform, and set up the monitoring locations at the coastal areas to collect the meteorological and air concentration data.

The tracer sampling equipment will be set up along the coastal shoreline.   The measurements include upper air measurements, a wind, temperature and turbulent measurement system using wind profilers (LAP-3003 radar profiler for the measurement of the vertical profile of wind speed and direction) with RASS (15 Mega–Hertz Radio Acoustic Sounding system for the measurements of the vertical profile of virture temperature), ceilometer for mixing height measurements, microwave radiometer, Sodar, and Lidar.

Revised Date: January 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s): Southern California

Administered By: Pacific OCS Region

Title: Scenarios for Replacing Conventional Energy with Offshore Renewable Energy along the Central California Coast

BOEM Information Need(s) to be Addressed: Understanding potential renewable energy development scenarios off California will aid BOEM in planning for leasing decisions, site and impact characterization, identification of cooperating agencies, and stakeholder outreach. This study will provide a foundation for the analysis required to prepare for future marine renewable energy development along the central coast of California through: 1) an understanding of the regional need for power generation; 2) delineation of feasible scenarios of offshore wind and wave energy projects for a specific planning area; 3) consideration of compatible activities that may be proposed with an offshore renewable energy project, such as desalination; and 4) the ability to understand, evaluate, predict, and monitor potential adverse impacts from offshore energy.

Approx. Cost: (in thousands) $400   **Period of Performance:** FY 2016-2018

Description:

Background: Demand for electricity and water is increasing in California and nationwide. California's ambitious plans for renewable energy under the Renewable Portfolio Standard program requires investor-owned utilities, electric service providers, and other electricity aggregators to increase renewable energy resources to 33% of total procurement by 2020. In his January 2015 inaugural speech, re-elected Governor Brown announced his intention to take executive action to increase that renewable energy requirement from 33% to 50% by 2035. The need for renewable energy is further exacerbated in California because in 2009, the State Water Board banned a common method of cooling coastal nuclear power plants, which resulted in the closure of a 650 MW gas-fired plant in Morro Bay, San Luis Obispo County. Pacific Gas and Electric Company's 2,160 MW Diablo Canyon Nuclear Power Plant (Diablo Canyon) located just south of Morro Bay uses this type of cooling and when it shuts down California will be faced with a 2,800 MW total electricity shortfall in a short timeframe.

In addition to the potential shutdown of major power plants in the area, the central coast of California (Morro Bay area to Point Conception, a span of ~120 km) is an ideal, real-world location for the aforementioned analysis for a number of reasons: (1) low-cost grid interconnection options due to existing onshore power transmission infrastructure, (2) strong commercial interest in developing wave energy in the Morro Bay area—the Federal Energy Regulatory Commission has already issued two preliminary permits for wave energy projects in the area, (3) significant wave and offshore wind resources in the region, (4) critical local and regional need for freshwater, (5) offshore bathymetry in this area is well suited for wave energy and there are various

depth options suitable for floating offshore wind, and (6) the U.S. Department of Energy recently invested $750,000 in California Polytechnic State University, San Luis Obispo to determine the cost issues for locating a new federal wave energy test facility offshore Vandenberg Air Force Base (the CalWave study).

Objectives: The study objectives are:

1. To delineate feasible scenarios of offshore renewable wind and wave energy facilities with the capacity to compensate for a reduction in energy production by the recently shuttered Dynegy power plant at Morro Bay and Diablo Canyon's Units 1 and 2.

2. To assess the capacity of using hybrid facilities in the offshore environment— those facilities able to switch strategically between power generation (during high power demand periods – daytime) and desalination (during low-demand – night) for meeting regional power and local freshwater demands.

3. To identify information and resources needed to evaluate and predict the impacts of any specific proposal for offshore energy and freshwater production along the south-central coast, such that projects meet energy and freshwater demand and minimize environmental impacts and conflicts among ocean users.

Methods: An interdisciplinary team will be formed to execute this study. Engineers will evaluate the potential offshore renewable energy technologies, economists will quantify financial costs and benefits of these technologies, and marine ecologists, social scientists, and ecological modelers will determine what information is needed to evaluate the environmental and social suitability and tradeoffs of specific proposals.

To achieve Objectives 1 and 2, engineers, physical oceanographers, and economists will work collaboratively to provide quantitative estimates of the generating capacity of various facilities, the percent capacity under which they may operate given the developable wind and wave fields in federal waters along the central coast, and the costs of implementation and value of the resulting electricity and water.

For Objective 3, marine scientists will collaborate with engineers, oceanographers, and economists to identify information needed to evaluate the ecological and social suitability of specific offshore energy proposals. Key information will include spatial data on the distribution of habitat, biological resources associated with those habitats, spatial information on existing ocean uses, and identification of potential stakeholders and their attitudes and opinions. The work will focus on identifying information needed rather than generating new information, but it will gather relevant existing datasets.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Washington/Oregon

Administered By: Pacific OCS Region

Title: Recreation, Tourism, and Community Perspectives in Southern Oregon Before and After Offshore Wind Development

BOEM Information Need(s) to be Addressed: The WindFloat Pacific Offshore Wind Pilot Project (WindFloat Pacific Project) is on track to be the first offshore wind project in federal waters off the West Coast and the first full-scale project in the nation to use a floating structure to support offshore wind generation in the OCS. As such, the project provides a unique and valuable opportunity to gather observational data before and after the project is installed and operational, especially for socioeconomic resources such as recreation, tourism, and community perspectives. Information about how recreation and tourism behavior changes and how community perspectives change before and after an offshore renewable energy installation is entirely lacking in the U.S. because of the lack of installations. Such data will be valuable for verifying the National Environmental Policy Act (NEPA) analysis for the WindFloat Pacific Project, refining any monitoring and mitigation plans, adaptive management implementation, and future NEPA analyses for West Coast offshore renewable energy projects. This information can also contribute to West Coast marine spatial planning efforts, provide additional information for the BOEM Oregon Renewable Energy Task Force, and assist coastal planners in Oregon.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2016-2019

Description:
Background: BOEM has not performed a baseline assessment of recreation and tourism sectors in the Pacific Region since the late 1980s/early 1990s, when oil and gas development was being considered in the Washington/Oregon planning area. The *Pacific Regional Ocean Uses Atlas* study (BOEM 2014d) collected information on some recreation and tourism uses in Oregon and perspectives on offshore renewable energy development, but these uses were not the targeted focus of the study and the information is generally at a coarse resolution. Some baseline recreation and tourism information in the proposed WindFloat Pacific Project area is available from state agencies, universities, and non-governmental organizations in Oregon, though much of these data were collected on a statewide basis and/or are applicable to wave energy rather than wind energy.

Though this baseline information is available for use in WindFloat Pacific Project analyses, more site-specific, project-specific data both before and after Project installation are needed in order to better understand actual project impacts on visitation rates, recreation and tourism behavior, and perspectives on offshore wind energy development. The areas and groups of interest for these data are the onshore parks and public areas adjacent to the Project lease and staging locations, sportfishing operations,

and other charter boat operations (such as wildlife viewing charters) in the Project vicinity. Refined information would build upon the existing baseline data. This study could be modeled in part upon the ongoing BOEM study, *Atlantic Offshore Wind Energy Development: Public Attitudes, Values, and Implications for Recreation and Tourism* (BOEM 2014a).

In addition to a standard report, geospatial and time-series data on Project area visitation, recreation, and tourism would be expected.

<u>Objectives</u>: Questions to be answered by this study are:

- What is the nature and frequency of recreation (including sportfishing and charter boat operations), tourism, and visitation rates in the WindFloat Pacific Project area before the Project is installed?

- What are local community (Coos Bay and Charleston residents, recreators, and tourists) perspectives about offshore wind development before the Project is installed?

- What is the nature and frequency of recreation, tourism, and visitation rates in the WindFloat Pacific Project area after the Project is installed?

- What are local community perspectives about offshore wind development after the Project is installed?

If changes in recreation, tourism and visitation rates and/or perspectives are observed, what factors contributed to those changes?.

<u>Methods</u>: The objectives of the study can be accomplished by primary data collection in the WindFloat Pacific Project area. Suggested methods include:

- Synthesize existing information regarding recreation and tourism activities that may be impacted by offshore wind development and impacting factors (e.g., visual impacts from development on park visitation, recreational fishing impacts from creation of a Fishing Aggregation Device).

- Determine the best sampling method to gather before-and-after Project data (e.g., guided discussions, surveys with local communities/onshore public area visitors/charter boat clients) and design appropriate methodology to achieve project objectives.

- Design and create an Office of Management and Budget-approved survey.

- Collect survey data.

- Synthesize findings in a study report.

Revised Date: June 29, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Southern California

Administered By: Pacific OCS Region

Title: Assessing the Impact of Oil Spills to Subsurface Biota
using Three-Dimensional Oil Spill Modeling

BOEM Information Need(s) to be Addressed: Currently the offshore oil and gas risk analysis conducted by the BOEM Pacific Region is based on a two-dimensional oil spill model, which only predicts surface transport of oil spills. However, oil spills can have significant impact to the subsurface. The impact of oil spills to the subsurface can only be predicted using three-dimensional oil spill modeling. The aim of this study is to implement a three-dimensional oil spill model in southern California and to assess the impact of oil spills to subsurface biota. This study will expand BOEM Pacific Region's capability to conduct oil spill risk analysis in southern California.

Approx. Cost: (in thousands) $400   **Period of Performance:** FY 2016-2017

Description:
Background: BOEM Pacific region currently uses the General NOAA Oil Modeling Environment (GNOME), which is a two-dimensional oil spill model, for oil and gas risk analysis. This model can only predict oil spill risk to surface biota and to habitats located on the beach and in the intertidal zone. However, oil spills transport oil and its by-products into the subsurface, both the water column and the sediments, posing a risk to pelagic and benthic biota. Through this study, the fate and transport of oil spills in southern California will be predicted using a high-resolution, three-dimensional oil spill model. Predicting the three-dimensional fate and transport of oil spills will allow BOEM to assess the risk to subsurface biota and meet the needs of the BOEM Pacific Region's offshore oil and gas program.

Objectives: There are two objectives to this study:

1) Implement three-dimensional oil spill modeling; and

2) Assess the oil spill risk to subsurface biota.

Methods: The three-dimensional oil spill model will be based on a high-resolution (1 km) Regional Ocean Modeling System (ROMS) and will use particle tracking to simulate the fate and transport of the oil. Using particle tracking to simulate the fate and transport of oil spills is a widely used and well-accepted practice. The ROMS predictions for 11 years from 2004-2014 are already under development by the University of California Los Angeles through an ongoing BOEM study, *Expansion of West Coast Oceanographic Modeling Capability* (BOEM 2014c), which will be completed in FY 2016. The particle tracking for the proposed study will be modified so that the particles represent the physical properties of oil. Using realistic oil spill scenarios over a range of different oceanographic regimes (such as upwelling,

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247

relaxation, and eddy-driven flow), the three-dimensional fate and transport of the oil will be simulated. BOEM will supply realistic oil spill scenarios and a range of oil products to be modeled. By simulating these oil spill scenarios, areas of high risk in the subsurface, both the water column and benthos, can be identified. Using available geologic and marine habitat maps of the region, the impact of oil spills on these biota will be assessed.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Southern California, Washington/Oregon

Administered By: Pacific OCS Region

Title: Disturbance Index Development for the Pacific OCS

BOEM Information Need(s) to be Addressed: This study implements BOEM's Outer Continental Shelf Lands Act mandate to monitor the marine environments adjacent to OCS operations and to have some measure of evaluating cumulative impacts from past and ongoing operations. Information on seafloor invertebrate species and abundances in the vicinity of existing federal platforms in the Pacific OCS was last collected over 17 years ago, yet is still the basis of ongoing current environmental assessments. The proposed study will develop an index to regionally assess and rank the degree of anthropogenic disturbance for outer shelf and slope soft-sediment biological communities in areas surrounding platforms in the southern California OCS. By doing this we can assess the status or "health" of the seafloor regionally and compare to OCS projects that will impact the soft-bottom habitat. This information will be used in all environmentally based planning, from current biological assessments of critical habitat for white abalone to regional-level decommissioning decisions. Developing a quantitative index for disturbance of seafloor areas is a tool that can be applied to other regions on the Pacific OCS, where there is current interest in renewable energy development.

Approx. Cost: (in thousands) $150   **Period of Performance:** FY 2016-2018

Description:
Background: Invertebrates found in the seafloor sediments (infauna) are often used to assess sediment quality because they are adapted to site-specific conditions such as grain size or total organic carbon. They integrate the cumulative effects of multiple co-occurring contaminants and stressors over time. A well-established method for evaluating impacts from offshore platforms is to conduct community-level analysis of the benthic invertebrates near and far from a platform. A preferable method is to use regional reference conditions, far from the source, instead of a single site. A regional reference condition captures the full range of natural variability, enables a more robust analysis, and prevents potential false-positive findings from a single site comparison.

To assess cumulative impacts from multiple sources and to improve capacity for regional assessments, the Southern California Coastal Water Research Project (SCCWRP) facilitates a regional seafloor sampling effort every five years. Local, state, and federal agencies partner through SCCWRP to sample over 350 locations in southern California, from estuaries to beyond the continental slope (SCCWRP 2014).

Results of the SCCWRP sampling show that the southern California seafloor is a patchwork of distinct biogeographic communities that separate generally by depth. As a result, infauna communities around federal platforms are different depending on their depth. The last four regional sampling efforts have focused analyses and reporting more

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249

on areas up to 400 meters of the mid and inner continental shelf and therefore have not fully described these biogeographic differences in deeper waters of the outer shelf and slope habitats. An improved understanding of what is "normal" or considered unimpacted habitat at these different depths is the first step in assessing the cumulative seafloor impacts from the nine platforms and infrastructure on the outer shelf and slope.

Objectives: A question to be answered by this study is, "What is the ecological condition of the outer continental shelf and slope in southern California?" More specifically for BOEM: "What are the sediment and benthic communities near the nine outer shelf and slope platforms? Can the tools developed through this proposed study be applied to future renewable energy activities on the Pacific OCS?"

Methods: Taxonomic and chemical data were collected by multiple state agencies for almost 20 years and analyzed, but need to be synthesized in a report for the outer continental shelf and slope areas. Statistical analyses will include processed data for organismal, physical, toxicology (including PAHs), and location data in the depth regions of federal platforms. Analyses will utilize multivariate statistical testing and correlations among biological, physical, and chemical parameters to test for similarities and differences among infauna samples. A separate analysis incorporating historic samples will be conducted to determine temporal trends. A regional reference condition termed "Benthic Response Index" is used regularly for inner and mid-shelf impact studies. This proposed study will develop the Benthic Response Index for outer shelf and slope depths to use in future impact analysis of federal platforms. A report will be written that describes the analysis and has complete GIS products including a map of distinct seafloor communities in the Southern California Planning Area at shelf and slope depths. There will be particular focus on evaluating the application of this index for evaluating sedimentary changes associated with floating wind and wave energy facilities.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Southern California, Washington/Oregon

Administered By: Pacific OCS Region

Title: Predicting Species Distribution and Habitat Alteration
Based on Sea-level Rise

BOEM Information Need(s) to be Addressed: BOEM conducts environmental reviews of OCS energy projects in accordance with the National Environmental Policy Act (NEPA). Energy projects typically have a long lifespan and require evaluation of impacts across several decades. In particular, BOEM needs to be able to project and analyze the potential for large environmental changes affecting resources also potentially impacted by offshore energy projects. Sea-level rise is one of the large changes expected to significantly impact our coastline over the next several decades that needs to be considered in our environmental reviews. Importantly, sea-level rise is anticipated to significantly alter the distribution of coastal and migratory species due to a variety of factors, such as availability of beach and rock space for nesting, brooding, hauling out, pupping, etc., and redistribution of prey species.

However, site-specific information addressing the expected/predicted changes from sea-level rise is not available. The predictive sea-level rise information that currently exists for coasts is either focused on the human environment or is at a large landscape scale and is not conducive to a BOEM-scale NEPA analyses. This study will produce a predictive tool for evaluating changes to species patterns and habitats based on sea-level rise for coasts adjacent to OCS energy projects.

Approx. Cost: (in thousands) $250   **Period of Performance:** FY 2016-2018

Description:
Background: When averaged over all the world's oceans, sea level has increased at a rate of roughly 0.6 inch per decade since 1880; notably, the rate of increase has accelerated in recent years to more than 1 inch per decade (EPA 2014). The amount of change, however, is variable. Areas along the Atlantic coast and upper coast of Alaska have experienced as much as an 8-inch increase over this period; whereas, shorelines off Oregon, California, and Hawaii increased by 2 to 6 inches, and some sections of the northern Washington coast decreased by 2 to 4 inches over the same period. Rocky shores in particular are susceptible to sea-level rise effects such as "coastal squeeze", resulting in reduced intertidal area and steepening shore profiles (Haslett 2000) (Kendall, et al. 2004) and increased wave heights (Ruggierio 2013). All of these factors affect wildlife and intertidal organisms found on rocky shores. Reduced availability of sandy beach space and redistribution of prey affects wildlife using that habitat.

In the proposed study, 5 20-kilometer segments of shoreline would be selected for evaluation based on their habitat value and use by at-risk populations of seabirds, shorebirds, marine mammals, or invertebrates. It is anticipated that 3 sites would be in the southern California area adjacent to OCS oil and gas facilities; and 2 segments would

be located in the Pacific Northwest in proximity to emerging renewable energy projects. It is anticipated that the Bureau of Land Management (BLM) may contribute to this study, specifically for an additional segment of offshore rocks at Point Conception (in the California Coastal National Monument), where at-risk seabirds nest and roost, which would add to the ability to evaluate these populations.

A multi-disciplinary team would be employed to provide the expertise needed for the project. Digital elevation models (DEMs) would be created using existing high-resolution LiDAR data and GIS data. These DEMs would be used to assess the vulnerability of key habitats and biota under different scenarios of sea-level rise. This study builds on a successful U.S. Geological Survey (USGS) effort to evaluate sea-level rise effects for coastal wetlands along the Pacific coast. Scientists at the USGS Western Ecological Research Center in San Francisco and Vallejo and their partners are using a collaborative approach to create tools scaled to the level needed by managers. In the USGS study, data collected at 18 coastal wetland sites are being used to project reliable estimates of climate change impacts at regional scales (USGS n.d.). Some additional leveraging of this work may be possible if BOEM-selected segments overlap with sites where USGS has already developed DEMs.

Objectives: The objective of the study is to provide an easy-to-use tool to predict changes in habitat and resulting effects at the species level from relative sea-level rise along critical shoreline segments adjacent to OCS energy projects.

Methods: Segments would be selected based on BOEM needs, prioritization of species, and availability of data. Detailed DEMs of the shoreline using high-resolution LiDAR and GIS data will first be created under different sea-level rise regimes that use a range of low, mid, and high sea-level rise rates which incorporate rates of uplift and subsidence in their projections (National Research Council 2012). These regimes will be selected based on current downscaled projections of sea-level rise over near and long-term time scales. The parameters modeled, species prioritization, and vulnerability assessment will be collaboratively developed to ensure maximum usefulness by BOEM. Species priority will be based on their status, importance as prey and habitat structure, and usage of shoreline as critical foraging, roosting, nesting, resting, or pupping areas.

The DEM models will be used to apply the identified changes to alterations in usable habitat for vulnerable species under different sea-level rise scenarios. The focus of the analysis will be on selected seabird, shorebird, marine mammal, and invertebrate species which BOEM analysts believe are critical to our analyses and for which we have sufficient baseline data from existing studies. Habitat changes will be linked to potential effects on key resources using vulnerability assessments. The final product will be a predictive model allowing for analyst inputs and scaling features for understanding habitat/species-level effects under defined sea-level rise scenarios. User-friendly interfaces allowing analysts to readily access the information at their desk will be designed and implemented. See example at (Climate Central 2013).

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s): Southern California, Central California, Northern California, Washington/Oregon

Administered By: Pacific OCS Region

Title: California Current Cetacean and Ecosystem Assessment Survey and Use of Data to Produce and Validate Cetacean and Seabird Density Maps

BOEM Information Need(s) to be Addressed: The Energy Policy Act of 2005 authorized BOEM to regulate renewable energy activities on the OCS. As part of this responsibility, BOEM is tasked with conducting detailed environmental analyses of proposed renewable energy projects. These analyses include evaluating the potential direct, indirect, and cumulative impacts on the marine environment, including marine mammals and seabirds. They will allow BOEM to make environmentally sound decisions about managing renewable energy activities and developing mitigation measures to minimize their impacts. The proposed study would provide data and analytical products to enable BOEM to fulfill these responsibilities.

Approx. Cost: (in thousands) $100   **Period of Performance:** FY 2016-2017

Description:
Background: Since 1996, the National Oceanic and Atmospheric Administration's (NOAA) Southwest Fisheries Science Center (SWFSC) has conducted comprehensive marine mammal and ecosystem surveys along the entire U.S. West Coast every 3-6 years to estimate the abundance of marine mammal populations and monitor status and trends. These surveys provide a broad-scale basis for managing marine mammal stocks within an ecosystem context that includes seabirds, prey sampling, and oceanographic measurements. BOEM provided partial support for a 2014 (August-December) survey that included fine-scale data collection in two offshore Oregon areas of special interest to BOEM: the Pacific Marine Energy Center-South Energy Test Site (PMEC-SETS) and the WindFloat Pacific site off Coos Bay, in addition to the standard survey grid (U.S.-Mexico border to U.S.-Canada border and seaward to 300 nautical miles).

Objectives: The proposed study has two primary objectives:

1. Repeat the 2014 survey in 2016 in order to provide a second survey of the marine mammal and seabird communities located a) within the PMEC-SETS and WindFloat sites, and b) within the greater California Current, in a manner that is consistent with previous and ongoing large-scale studies of these species by NOAA. The two surveys will provide an opportunity to investigate effects of interannual variation in physical oceanography on distribution, abundance, and ecology of marine mammals and seabirds, because 2014 was an unusually warm year.

2. Produce density maps of common marine mammal and seabird species in the two BOEM regions of interest off the coast of Oregon using a habitat-based spatial modeling framework.

Methods:

1: In summer/fall 2016, NOAA's SWFSC will conduct visual and acoustic line-transect surveys for cetaceans and visual strip transects for pinnipeds and seabirds within the entire California Current and within two areas of special interest to BOEM off the Oregon coast using a dense grid of fine-scale transect lines. Surveys will be conducted from the NOAA R/V *Reuben Lasker* using methods identical to those used in the BOEM-funded 2014 survey (details in BOEM Interagency Agreement M14PG00017).

2: Habitat-based densities for common marine mammal and seabird species will be modeled at a 5-km pixel resolution (or finer if supported by the data), using established modeling frameworks that have been developed and extensively evaluated by scientists at the SWFSC, NOAA Fisheries (e.g., (Barlow, et al. 2009) (Forney, et al. 2012) (Becker, et al. 2010) (Becker, Foley, et al. 2012)). Habitat data will include static variables (e.g., depth, slope, distance to land) and satellite-derived dynamic predictors (e.g., sea surface temperature, chlorophyll concentration, frontal indices). Survey data from the entire study area and all survey years will be used to address any sample size issues arising from potentially low numbers of sightings within the two BOEM areas of interest, to validate models, and to incorporate inter-annual variation.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Washington/Oregon

Administered By: Pacific OCS Region

Title: Analysis of Long-term Seabird Colony Legacy Data in the Pacific Northwest as a Regional Baseline

BOEM Information Need(s) to be Addressed: Several offshore wind and wave energy development projects are currently being planned off the coast of Oregon and include the WindFloat Pacific Project. Such energy projects offshore of existing seabird colonies could potentially have effects on seabirds breeding within the Oregon Coast National Wildlife Refuge Complex and Washington Maritime National Wildlife Refuge Complex. The goal of this proposed study is to process, analyze, and summarize long-term seabird colony abundance and distribution data collected by the U.S. Fish and Wildlife Service (USFWS) and to produce products available for use in impacts assessments under the National Environmental Policy Act. It will provide an environmental baseline against which to evaluate potential effects of region-wide offshore energy development projects on West Coast seabird breeding colonies and populations. This study would enable comparisons of bird attendance between colonies and project sites before and after project installation. The proposed study would conform with the Outer Continental Shelf Lands Act of 1953, (43 U.S.C. 1331 et seq.), which specifies that studies conducted by federal agencies of coastal areas which may be affected by energy sales and leases may be utilized in lieu of BOEM directly conducting such activities.

Approx. Cost: (in thousands) $420   **Period of Performance:** FY 2016-2018

Description:
Background: Aerial photographic seabird colony surveys have been conducted annually off coastal Oregon since 1988 and in coastal Washington since 2010. The current state of knowledge of Oregon seabird colonies is based on counts of a sub-sample of aerial images because budget constraints have prevented the processing of more than a small portion of the Oregon images. Although the entire coast of Oregon is surveyed, only about 12% of the total 393 colonies are counted each year. The processing, counting, and analysis of all images through this study would improve our understanding of the population trends and changes to distributions of breeding seabirds along the entire Oregon coast in response to changing resources and other influences. Additional interest in this study stems from concerns that earlier slide images, taken using color film, are beginning to degrade and without digitization, processing, and archiving, will be lost. This study would allow USFWS to archive, process, manage, analyze, and report 26 years of previously unprocessed photographic data in Oregon, which is the only long-term baseline data set of its kind for seabird colonies in the Pacific Northwest. The study would also conduct similar work on a less-extensive data set from Washington. This study will provide colony counts for Oregon seabird colonies from 1988 to the present and for Washington from the early 2000s and from 2010 to the present. It will also produce an analysis and interpretation of the resulting dataset into a final report

assessing status and trends of breeding seabirds over the 26-year period. All colony count data will be made available to BOEM as georeferenced database files and through online portals, including MarineCadastre.gov, the North Pacific Seabird Colony Register, and the Avian Knowledge Network. Opportunities to integrate these seabird data with other established monitoring programs (e.g., Multi-Agency Rocky Intertidal Network, Pacific Rocky Intertidal Survey and Monitoring) and new monitoring networks (e.g., Marine Biodiversity Observation Network) will also be assessed.

BOEM has recently funded several studies to document at-sea movements, flight behaviors, and distributions of seabirds along Oregon, Northern California, and Washington in order to inform planning and assess effects of offshore energy development on seabirds and their habitats (see (BOEM 2014b) (Adams, et al. 2014) (BOEM 2014e) (BOEM 2014f)). The proposed study would complement those ongoing studies by providing baseline data on seabirds at colony sites along the Oregon and Washington coasts. Although energy projects might most directly affect seabirds through mortality from collision with energy devices, indirect effects to seabird colonies are possible by obstruction of flight corridors to foraging areas, interruption of foraging and other behaviors, and attraction to energy project sites. Comparisons between the studies listed above and the proposed study would help assess whether seabird breeding or feeding distributions change as a result of offshore energy projects.

Objectives: The objectives of this proposed study are to: 1) process, archive, and analyze USFWS's long-term seabird colony dataset for Oregon and Washington to establish population trends and distributions of nesting seabirds; 2) populate and maintain a database that will be readily accessible to BOEM for use in impacts assessments; and 3) produce reports or scientific publications that will be readily available to BOEM, the scientific community, the general public, and other government agencies.

Methods: USFWS will process and analyze aerial images of seabird colonies taken annually in coastal Oregon since 1988 and coastal Washington since 2010. Approximately 50,000 film slides taken from 1988 to 2008 must be professionally scanned, managed, and archived before they can be digitally counted. These oldest and most vulnerable color film slides will be processed first. All images taken after 2008 are digital and have been archived in three locations. Digital images will be graded and digitized, and the highest-quality images of each colony will be digitally counted using GIS for several species, including common murre, Brandt's cormorant, and double-crested cormorant. The resulting counts will be entered into a georeferenced database. Count data will then be analyzed to compare spatial and temporal variability of colony counts between seasons as well as long-term seabird colony trends. Data will be summarized into a final report, published papers, and scientific presentations at conferences and meetings, as appropriate. Data will be made readily accessible to BOEM, the science community, and the general public as a georeferenced database, as well as through online portals.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Southern California

Administered By: Pacific OCS Region

Title: Baseline Characterization of Unsurveyed Southern
                          California Rocky Intertidal Communities

BOEM Information Need(s) to be Addressed: This study builds on the BOEM-MARINe (Multi-Agency Rocky Intertidal Network) study by adding a tool that allows for a broader assessment of impacts to rocky intertidal communities in the event of an OCS oil spill. The data collected and products generated from this study will augment information for BOEM scientists and planners about locations of the rarest and most sensitive biological communities in rocky intertidal zones, provide greater detail to habitat maps used for spill response, and be used to assess injuries from OCS oil spills on Department of the Interior (DOI)-managed lands in southern California. This study will be leveraged with additional funding provided through the participation of two other DOI bureaus, the Bureau of Land Management (BLM) and the National Park Service (NPS).

Approx. Cost: (in thousands) $125   **Period of Performance:** FY 2016-2018

Description:
Background: BOEM has collected two decades of rocky intertidal data adjacent to Pacific OCS oil and gas operations. Through our coordination of the MARINe network of sites along the Pacific coast and offshore islands and the MARINe database, we have a wealth of information that allows us to extrapolate to other remote sections of the coastline, provided certain other information about the habitat has been collected. The University of California Santa Cruz (UCSC) has developed a ground-based protocol (UCSC 2010), which, when used in conjunction with LIDAR (Laser Imaging Detection and Ranging) technology and MARINe data, can be used to classify rocky intertidal habitats along large sections of unsurveyed coastline. This integrated approach is especially valuable for characterizing shorelines that are hazardous and difficult to reach. Another benefit of the study is validating existing habitat maps routinely used for spill response. In the areas where this protocol and remote imaging have been completed, significant errors have been discovered, which would have otherwise delayed deployment or caused deployment of the incorrect teams to an area. For example, sections of coastline identified as sandy were found actually to be rocky and largely inaccessible.

Objectives: The objective of this study is to characterize the rocky intertidal habitats of undocumented sections of the mainland coast and offshore islands to facilitate assessment of impacts from an OCS oil spill in the Santa Barbara Channel or San Pedro Bay.

Methods: Initially, researchers will research, collect, and integrate existing data from diverse sources to select appropriate shoreline sites for the study. The focus of this

study will be on less-studied sections of the offshore islands in the Santa Barbara Channel and along the Palos Verde Peninsula near Long Beach. Work will be coordinated with managers at BLM (for sites in California Coastal National Monument) and NPS (for sites in Channel Islands National Park). Sites will be selected based on (1) their susceptibility to oiling from OCS oil and gas facilities and (2) the need for shoreline habitat characterization.

Following site selection, LIDAR imagery will be acquired and on-the-ground field work will be performed concurrently to collect critical physical and biological parameters (e.g., slope, aspect, and key species) at selected sites, and correlations between remotely sensed and ground-based field data sets will be identified. Access points will also be identified and mapped to assist with oil spill response. Using correlations between the LIDAR images and field data, researchers will develop a predictive model to characterize unsurveyed intertidal communities on the basis of their similarities to known communities already surveyed by MARINe.

This study will support BOEM's National Environmental Policy Act (NEPA) analyses and oil spill assessments, as well as decision-making by other federal and state agencies, including BLM (California Coastal National Monument), NPS (Channel Islands National Park), U.S. Coast Guard, California Department of Fish and Wildlife, and California Office of Spill Prevention and Response.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Southern California, Central California, Northern
                               California, Washington-Oregon

Administered By: Pacific OCS Region

Title: Predicting and Detecting the Effects of Climate Change
                               and Ocean Acidification Using Long-term Ecological Data

BOEM Information Need(s) to be Addressed: The purpose of this study is use
Department of the Interior (DOI) long-term monitoring programs to predict how global
climate change and ocean acidification will alter rocky reef ecosystems in southern
California and to detect effects already underway. The need for this study is to increase
our understanding of kelp forest dynamics, construct likely scenarios for future kelp
forest communities, and determine whether ocean acidification has had measureable
effects on vulnerable species thus far. These results will help BOEM managers predict
and detect the effects of offshore energy activities by describing baseline environmental
conditions and how they are shifting. The study may also inform collaborative ocean-
stewardship efforts in which BOEM participates, including in support of the National
Ocean Policy and West Coast Governors Alliance on Ocean Health, both of which have
identified ocean acidification as a priority area.

Approx. Cost: (in thousands) $250   **Period of Performance:** FY 2017-2018

Description:
Background: Climate change is likely to substantially alter the physical processes
structuring nearshore rocky reef ecosystems over the coming decades. In southern
California, anticipated physical effects include increases in temperature and a reduction
in ocean pH, as well as changes in the frequency and severity of wave disturbance
events. It is unclear how these changes in the physical environment will influence the
ecological communities on southern California's reefs, but knowledge of how these
communities will change is critical to BOEM's ability to predict and detect the effects of
offshore energy activities in these coastal ecosystems.

In nearshore waters off southern California, climate change is occurring within a system
already strongly influenced by several natural sources of interannual and interdecadal
climate variability, including the Pacific Decadal Oscillation, the North Pacific Gyre
Oscillation, and the El Niño-Southern Oscillation. In one sense, this background
variability poses an obstacle to studying the effects of climate change in this region. To
detect long-term anthropogenic change, the influence of these natural variations must
be described. However, this historical variability also presents a key opportunity for
studying the effects of climate change. Because in many cases the anticipated future
state of key environmental drivers is not unprecedented, analysis of the historical
responses of kelp forest ecosystems to natural climate variability can be used to
anticipate likely future outcomes of anthropogenic climate change.

Fortunately, data exist to perform these analyses, including 30 years of data on kelp forest community structure collected by two DOI bureaus (U.S. Geological Survey and National Park Service). Previous work funded by BOEM began a syntheses of these data (in partnership with University of California Santa Barbara), and much of the work necessary to make the data useful for analyses has already been done. The timespan of these data includes periods much warmer than the present (including two of the strongest El Niños on record) and a wide range of wave and upwelling conditions. Long-term data on several key environmental drivers are available to supplement this biological dataset.

In addition to helping predict the effects of climate change, the understanding derived through these analyses will aid in detecting ongoing effects of change. For example, we could better detect the effects of ocean acidification on nearshore ecosystems with a better understanding of their natural dynamics. We have strong evidence from laboratory studies that the decreasing pH of nearshore waters can have strong negative effects on calcifying organisms, particularly those that depend on aragonite for building their shells and skeletons. However, to detect the effects of acidification in nature, we must account for variability in other environmental factors.

Objectives: The goal of this study is to predict how global climate change and ocean acidification will alter rocky reef ecosystems in southern California and to detect effects already underway. The study will increase our understanding of kelp forest dynamics, construct likely scenarios for future kelp forest communities, and determine whether ocean acidification has had measureable effects on vulnerable species thus far. These results will help BOEM plan for future changes in nearshore ecosystems, and will help managers predict and detect the effects of offshore energy activities.

Methods: Historical data on kelp forest communities will be analyzed to determine how key environmental drivers have changed kelp forest communities over the past 30 years. Because multiple drivers have changed over this period, structural equation modeling will be employed to isolate the interacting effects of each driver. These effects will be incorporated into predictive models of future rocky reef communities. Scenarios for the future state of environmental drivers will then be assembled from the literature, and models will predict future community change based on past dynamics and likely oceanographic conditions. The effects of ocean acidification will be evaluated by classifying species in the long-term data based on their vulnerability to acidification (e.g., reliance on calcification, aragonite dependence – long-term data include more than 30 species of invertebrates and algae, encompassing the full range of vulnerability to acidification). The dynamics of vulnerable and less vulnerable species will be compared to determine whether a divergence has occurred. Spatial gradients in upwelling will also be examined to test whether species vulnerable to acidification have suffered steeper declines in areas characterized by more corrosive upwelled waters.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Southern California

Administered By: Pacific OCS Region

Title: Pacific Regional Investigation Survey and Monitoring (PRISM)

BOEM Information Need(s) to be Addressed: BOEM Pacific Region staff manage multiple cooperative agreements that require substantial government involvement. This study will be used to continue to monitor effects of OCS oil and gas operations, including those from accidental oil spills, on the nearby shoreline habitats. This study will also be used in a broader context to support staff beyond shorelines effects that are related to active studies or to test new study ideas on a small scale.

Approx. Cost: (in thousands) $100   **Period of Performance:** FY 2017-2021

Description:
Background: The Outer Continental Shelf Lands Act states in 43 U.S.C 1345 Section 20 (3)b that "Subsequent to the leasing and developing of any area or region, the Secretary shall... monitor the human, marine, and coastal environments of such area or region in a manner designed to provide time-series and data trend information which can be used for comparison with any previously collected data for the purpose of identifying any significant changes in the quality and productivity of such environments, for establishing trends in the areas studied and monitored...".

Achieving this goal in a cost-effective manner often requires research and small-scale trials. This is particularly true for offshore renewable energy planning because there are currently no commercial operations in the U.S. The BOEM PRISM team (formerly the MMS Intertidal Team or MINT) was initiated in 1991 and is one of 12 monitoring teams that collect data for the Multi-Agency Rocky Intertidal Network (MARINe), which conducts rocky intertidal monitoring at over 120 established sites. However, in addition to the biannual monitoring of established rocky intertidal sites, PRISM staff design and implement individual studies of associated resources to answer questions identified in the field during this monitoring, and to support the overall BOEM mission. These small-scale field questions have led to reports and publications, additional skills, and the development of large-scale successful studies. PRISM presence in the field has the added benefit of interacting with the public during monitoring and provides BOEM with the opportunity to demonstrate our commitment to the environment in a visible manner.

Objectives: We want to expand the use of these funds beyond rocky intertidal shorelines and be of use to benefit in-house staff ideas relevant to the BOEM mission and improve our understanding of the effects of OCS activities through the direct investigation by BOEM staff in field. This study will support our commitment to participate in the cooperative agreements.

The first objective is to collect data in the field to monitor the shoreline adjacent to existing oil and gas operations. By collecting data about natural and anthropogenic perturbations in the rocky intertidal habitat, BOEM will then have the basis to determine cumulative effects from OCS operations. BOEM funds a separate study for the monitoring, analysis, and publication of these data and management of the MARINe network, which spans two coastlines. Additional objectives will be determined annually.

Methods: Ideas for studies or activities will be decided at the beginning of the fiscal year and reviewed by Pacific Region and Headquarters management in an Annual Study Plan. The first task will continue to be biannual rocky shore monitoring and remains the same throughout the five-year program. Additional tasks will include special short-term studies designed by staff to address specific questions, or efforts which support the monitoring task. Examples of the range of topics previously pursued by the PRISM team include testing new protocols, developing archiving protocols, analyzing data from special studies, devising new field mapping efforts, and developing rapid shoreline field response protocols. Future tasks could include diving or socioeconomic or cultural topics.

For the monitoring task, PRISM biologists will collect data at the 32 sites established in the four counties adjacent to OCS oil and gas platforms (i.e., Santa Barbara, Ventura, Los Angeles, and Orange counties) and will work directly with university biologists. Individual staff members are expected to complete 2-15 sites over 2-10 field days each year.

The PRISM team has begun to investigate how our existing field efforts can inform environmental analyses of future lease sales for renewable energy projects, and that effort will continue in the proposed study. Offshore commercial-scale wave energy devices are predicted to alter the physical environment, specifically wave energy and sediment transport, which could in turn affect the biological communities. Detecting changes from energy devices requires ongoing monitoring before devices are in place. The PRISM team assisted MARINe in establishing five sites in Oregon to monitor biology and wave height. The team also works with university and National Park Service biologists to deploy and maintain a network of pH sensors in the Santa Barbara Channel.

Revised Date: May 14, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   North, Mid-, South Atlantic, and Straits of Florida

Administered By: Gulf of Mexico OCS Region

Title: Atlantic OCS Science Forum for Oil and Gas Decision
Making - Information Sharing and Assessing Research
Needs for Human and Environmental Resources

BOEM Information Need(s) to be Addressed: The results gained from the science forum will provide the necessary available data and information to BOEM's SMEs and NEPA Coordinators for preparation of future Atlantic OCS NEPA documents. Information compiled will be used by BOEM staff to prepare NEPA documents and consultations. Applicable sections for NEPA documents include the Affected Environment, Impact Analysis, and Cumulative Impacts and Analysis. Consultations that would utilize this information include, but not limited to, Endangered Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act, Clean Water Act, Clean Air Act, National Historic Preservation Act, National Marine Sanctuaries Act, Executive Order 13175: Consultation and Coordination with Indian Tribal Governments, and Fish and Wildlife Coordination Act.

Approx. Cost: (in thousands) $350   **Period of Performance:** FY 2016-2017

Description:

Background: Initially, the regional focus in the Atlantic was on the oil and gas potential. The last oil and gas sale was held in 1983 and the leases were relinquished in 2000. In 1985 a Final EIS was prepared for Lease Sale 111; however, the lease sale was cancelled because of a lack of interest from industry. After a moratoria in the Atlantic Region was lifted in 2008, planning for an oil and gas lease sale off Virginia was initiated as planned in the 2007-2012 Revised Program. In March of 2010, the President proposed opening the Mid- and South Atlantic OCS Planning Areas for leasing. After *Deep Water Horizon*, the proposal for Lease Sale 220 of Virginia was removed from consideration.

Within the last few years development within the Atlantic OCS has mainly focused on activities related to renewable energy development and marine mineral projects for beach and coastal restoration. Currently activity and interest is increasing again for offshore oil and gas exploration and development in the Atlantic OCS with the issuance of the Record of Decision (ROD) for geological and geophysical (G&G) surveys in the Mid- and South Atlantic Planning areas.

A workshop was held in December 2008 to identify environmental information needs in the proposed Lease Sale 220 area: (http://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Leasing /Regional_Leasing/Gulf_of_Mexico_Region/lsesale/220/MMS2009-011_4723.pdf). This workshop focused on environmental research needs specific to Virginia offshore areas. The recent studies that have been completed for the Atlantic Region are mostly focused on renewable energy and marine minerals, with a few studies related to oil and

gas exploration and development. With expanding activities in the Atlantic OCS, the understanding of existing data for resources evaluated in NEPA documents and Federally required consultations needs to be current and reflected in BOEM documents for the decision makers.

Objectives: The science forum will engage a wide range of experts and stakeholders to achieve the following goals: (1) To provide a public information opportunity on BOEM's programs, (2) To provide necessary information/data to BOEM in support of NEPA documents and consultations, and (3) To discern research needs/gaps for BOEM's Environmental Studies Program.

Methods: The science forum will consist of a presentation of the findings to BOEM staff to include technical presentations for each subject area selected by BOEM SME's. The findings will be presented to BOEM by up to three leading experts in the subject matter field. It is anticipated that up to 14 subject areas would be covered in depth. Topic areas will cover resources such as benthos, marine mammals, sea turtles, water quality, air quality, fisheries, socioeconomics, etc. The presentations to BOEM staff will be held over a three-day period in the Atlantic region. The contract deliverables will include:

1. A literature synthesis of historic and current government, academics, and peer-reviewed publications related to past and current status and issues for each of the selected resources BOEM chooses;

2. Preparation of a power point presentation of findings regarding past, current, and future status and issue for each subject matter field, including providing information regarding future study or data gap needs; and

3. Preparation of geographic information system (GIS) maps and shapefiles (including metadata), showing the locations of past and current research/studies, identification of current available known resource mapping (i.e., location of sea turtle observances or underwater cable lines, etc.). GIS shapefiles and metadata will be a task deliverable to BOEM.

4. Task deliverable to present to BOEM staff the findings of the literature synthesis, GIS mapping, and information of past, current, and potential future status and issues of resources within the Atlantic OCS with specific focus associated with oil and gas related activities.

5. A Science Forum Proceedings that includes combined information of past, current, and potential future status and issues, powerpoint presentations, maps, and literature synthesis.

Revised Date: May 20, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Region

Title: Atlantic Deepwater Ecosystem Observatory Network
(ADEON) – An Integrated System for Long-Term
Monitoring of Ecological and Human Factors on the OCS

BOEM Information Need(s) to be Addressed: BOEM requires a mechanistic understanding of variable biological, physicochemical, and human use dynamics in Atlantic deep waters to address the potential impacts of oil and gas exploration and development activities. This study will establish an ecosystem observatory network in Mid and South Atlantic deep waters to provide baseline measurements and environmental monitoring capabilities across multiple disciplines, to help fulfill BOEM's obligations under the Outer Continental Shelf Land Act and other laws. Biological data on prey (e.g., plankton), fish, and marine mammal distributions and habitat use, as well as soundscape, are required for Essential Fish Habitat (EFH) and Endangered Species Act (ESA) consultations, in addition to MMPA Rulemaking. Physicochemical measurements of ocean currents, water quality, and meteorology/pollutants will improve BOEM's OSRA modeling and air quality modeling for meeting USEPA standards.

Approx. Cost: (in thousands) $4,000   **Period of Performance:** FY 2016-2020

Description:
Background: Sustained deep water measurements of biological, physicochemical, and human use factors are currently rare in the Mid and South Atlantic. An ecosystem-based approach is required in deep waters that provides an integrated perspective across multiple disciplines to enhance BOEM's role in environmental stewardship. A sustained network of deep water observatories would provide this ecosystem perspective through collection of multi-year, year-round measurements of regional processes and human use as part of an integrated system. Offshore Atlantic waters encompass a complex oceanographic regime and highly productive biological domain, as influenced by the shelf-slope break, the Gulf Stream, submarine canyons, and atmospheric/climatic forcing. The observatory will be part of the new generation of biologically-enabled ocean observing systems which can provide long-term measurements of plankton, fish, and marine mammal distributions. Passive acoustic data serves the dual purpose of providing both animal distributions and baseline soundscapes, as well as occurrence of human activities, such as vessel traffic and G&G surveys. As well, physical oceanographic, water quality, and air quality measurements obtained from the observatory network will inform BOEM's OSRA and air quality modeling and respective NEPA cumulative-impact analyses. Overall, the network will provide much needed baseline data in this frontier region and will provide capability for monitoring long-term environmental changes and testing BOEM mitigations, such as for G&G exploration activities and OCS-related pollutant emissions.

<u>Objectives</u>: The overarching goal of this 5-year study is to collect and analyze year-round ecological and human-use datasets to provide improved mechanistic understanding of ecosystem variability, and to develop a long-term monitoring presence in Mid and South Atlantic deep waters. Specific objectives include:

- Characterizing key prey, fish, and marine mammal distributions and their soundscape throughout the year to provide species presence and habitat data.

- Collecting oceanographic and atmospheric datasets which describe regional variability in water quality, physical oceanography, and air quality.

- Analyzing the full dataset to provide estimates of variability and underlying forcing mechanisms, including from anthropogenic activities.

- Contributing data towards testing the null hypothesis that BOEM activities do not impact OCS resources.

<u>Methods</u>: The interdisciplinary objectives of this study will be met through multi-year (initial 3 year) deployment of an integrated array of instrumented moorings in Mid and South Atlantic deep waters. The Government anticipates that ~5 moorings will be distributed from a northern extent off Virginia (Norfolk Canyon area) to a southern extent off Georgia (Blake Ridge area), with exact mooring location based on regional resources and processes of interest. Mooring instrumentation will include sensors for: (1) *Biology and Soundscape* – prey, fish, and marine mammal species and ambient noise levels (using optics- and acoustics-based technologies, including passive acoustic receivers), (2) *Water Quality* –hydrocarbons, oxygen, chlorophyll, and nutrients, (3) *Physical Oceanography* – pressure, temperature, salinity, and ocean currents, and (4) *Air Quality* – meteorology, ozone, and fine particulate matter. Near real-time data transmission from the buoys will expedite data analysis and understanding of offshore events as they occur. Regular ship-based support will provide mooring deployment, validation sampling, and instrumentation maintenance. Finally, time series analyses will be performed for all measured parameters and will provide a mechanistic understanding of forcing factors (e.g., storm events, anthropogenic activities, etc.) driving variability.

It is anticipated that this project will be sponsored under the National Oceanographic Partnership Program (NOPP) with co-sponsorships from other agencies and industry that share the common goals of this project. The ADEON system will be operated in synergy with other ocean observing assets in the Mid and South Atlantic to complement and leverage the existing backbone of regional monitoring. For example, the U.S. IOOS program (e.g., MARACOOS and SECOORA) and local universities support a range of ocean observing assets including gliders, animal tagging programs, remote sensing products, and HF radar, all of which could be leveraged by the ADEON program. Ultimately, funding will be sought beyond the current study to ensure that the network supports long-term environmental monitoring in deep waters to inform BOEM's conventional energy-related management needs.

Revised Date: May 4, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico Region

Title: Alternative Oil Spill Occurrence Estimators for the Atlantic
               Ocean – Fault Tree Method

BOEM Information Need(s) to be Addressed: Probabilistic estimates of oil spill occurrences will be necessary in order to produce NEPA documents for hypothetical oil and gas lease sales or developments in the Atlantic. Due to no existing offshore oil development in this region, it will not be possible to base these oil spill probability estimates on empirical data from the Atlantic region. This study is necessary to incorporate fault tree spill occurrence estimation into the NEPA analysis for potential Atlantic OCS oil and gas lease sales and development.

Approx. Cost: (in thousands) $300   **Period of Performance:** FY 2016-2018

Description:
Background: Oil spill issues have historically constituted a significant portion of public comments submitted on a lease sale or operator submitted plans of proposed exploration or development operations in offshore areas, such as the GOM Region. It is anticipated that the same public interest in the possibility of oil spill occurrence will also be true for the Atlantic Region. Since there has been no prior oil and gas development in the Atlantic, statistically significant non-Atlantic empirical data from the US Gulf of Mexico (GOM) and world-wide sources, together with their variance, should be used as a starting point to provide probabilistic estimates of oil spill occurrences. Next, both the historical non-Atlantic frequency distributions and spill causal distributions should be modified to reflect specific effects of an Atlantic setting, and the resultant fault tree model should be evaluated using Monte Carlo simulation to adequately characterize uncertainties treated as probability distribution inputs to the fault tree.

The Alaska OCS has incorporated such a fault tree approach since 2002. Many similar studies have been conducted in the Alaska region also due to the limited offshore development. The latest completed study - OCS Study BOEMRE 2011-030 and its results can be found in BOEM's ESPIS. The historical GOM data that the 2011 Alaskan study OCS Study BOEMRE 2011-030 uses extends only through 2006; however, there is an ongoing study AK-11-01 that will conclude in 2016 that should update the GOM statistics.

Objectives: To determine probabilistic estimates of oil spill occurrences for use for the development of environmental impact assessments for hypothetical developments in the US Atlantic Planning Areas. Due to the lack of offshore oil development in this region, it is not possible to base these oil spill probability estimates on historical empirical data from that region.

<u>Methods</u>: Use statistically significant non-Atlantic empirical data from the US Gulf of Mexico (GOM) and world-wide sources, together with their variance, as a starting point to determine probabilistic estimates of oil spill occurrences for use in the development of environmental impact assessments for hypothetical developments in the US Atlantic Planning Areas. This study will review and assimilate oil spill occurrence reports, data, and geo-hazard data from alternate sources and locations as needed.   Next, both the historical non-Atlantic frequency distributions and spill causal distributions will be modified to reflect specific effects of the Atlantic setting, and the resultant fault tree model will be evaluated using Monte Carlo simulation to adequately characterize uncertainties treated as probability distribution inputs to the fault tree. A series of studies, associated with successive lease sale scenarios, will be carried out and directed at developing and applying the fault tree methodology.

Any Atlantic specific effects will be introduced by systematically modifying and augmenting spill occurrence fault trees for each of the three main facility types; namely, pipelines, platforms, and wells. In the analysis itself, fault trees will be constructed for all representative categories of facilities, spill sizes, and water depth, and a calculation process used. With inputs as distributed values, the resultant spill rates will then be evaluated using a Monte Carlo process. These spill rates will then be combined, again using Monte Carlo simulation methods, with specific development scenarios consisting of specified numbers of wells, platforms, and pipeline mileages, to give the estimated annual and life of field average oil spill occurrence estimators.

Revised Date: January 22, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Region

Title: Data Synthesis and Advanced Predictive Modeling of Deep
Coral and Hardbottom Habitats in the Southeast Atlantic:
Guiding Efficient Discovery and Protection of Sensitive
Benthic Areas

BOEM Information Need(s) to be Addressed: Knowledge of the distribution of
sensitive benthic biological habitats in deep water is necessary for management of
potential oil and gas development in the Atlantic region. Such information is needed to
define mitigations and avoid impacts to sensitive benthic habitats such as hardbottom
areas and coral communities. While the area south of Cape Hatteras contains some of
the most substantial deepwater coral habitat in U.S. waters, the vast majority of this
region remains unexplored and unmapped by modern acoustic or seismic techniques.
Further work is required to locate and characterize sensitive benthic habitats to guide
possible BOEM actions and assessments in this region. Yet, deep coral communities are
patchy, and hardbottom habitats are rare, so unguided field exploration is risky, costly,
and potentially ineffective. To efficiently and effectively map and explore sensitive
benthic habitats over a region as vast as the Mid/South Atlantic OCS, it is necessary to
develop the best possible predictive models of deepwater coral and hardbottom, and use
those models to prioritize mapping and exploration. Improved models will result in
better databases on known coral and hardbottom habitats, reduced cost and increased
success of mapping/exploration, and comprehensive region-wide maps of sensitive
benthic habitats. Such baseline habitat information is an important focus for BOEM
studies in the Mid and South Atlantic, informing Essential Fish Habitat consultations,
development of mitigation measures for potential oil and gas activities, and NEPA
sections on benthic communities.

Approx. Cost: (in thousands) $500   **Period of Performance:** FY 2016-2018

Description:
Background: A variety of sensitive deepwater habitats have been discovered in the Mid
and South Atlantic OCS, including deepwater coral communities and hardbottom that
support important demersal fish species such as the snapper-grouper complex.
Numerous sites have been investigated in the recent past and are summarized in
NOAA's Deep Sea Coral Research and Technology Program (DSCRTP) 2012 Report to
Congress. Though the 2009-2011 DSCRTP effort was intensive in some areas (primarily
off Florida) and documented unique and extensive coral/hardbottom habitats, this work
left vast expanses of potential habitat from North Carolina to Georgia unexplored and
unmapped. Recent predictive habitat modeling led by the NOAA National Centers for
Coastal Ocean Science (NCCOS) used historical presence-only data to generate maps of
potential deepwater coral habitat that have helped prioritize and guide field mapping
and exploration efforts in the U.S. Atlantic and Gulf of Mexico. Although helpful, these
first-generation presence-only models are limited in resolution and accuracy compared

to improved models possible when modern, precisely geolocated data on presence-absence, abundance, density, size, diversity, and other data are available on benthic communities. Therefore, BOEM has engaged NCCOS to synthesize data and develop improved deepwater benthic models for the Gulf of Mexico (Project 'Deepwater Coral and Chemosynthetic Atlas and Modeling Program: Gulf of Mexico' to start in FY15), and NOAA Fisheries has engaged NCCOS to develop similar model improvements for the Northeastern U.S. (Northeast Coral and Sponge Initiative, FY13-15). To date, the Southeast (SE) US has lacked funding to move beyond presence-only models of deepwater coral and habitat to make more accurate, high-resolution predictions of probability, abundance, and quality of benthic habitat in that large and complex region. Currently, there are no planned efforts to improve the presence-only models for the SE, leaving a large gap in anticipated state-of-the art predictive maps of benthic communities. That gap coincides with BOEM's information needs in the Mid and South Atlantic OCS. BOEM and NOAA's interest in improving data syntheses and models to guide more efficient mapping and exploration, combined with the challenge of efficiently exploring the vast Mid and South Atlantic OCS, make this proposal timely and important for BOEM and NOAA information needs.

Objectives: The goal of the proposed study is to produce region-wide high-resolution predictive spatial models and maps of the probability, abundance, density, and quality (e.g., locations of highly-developed, diverse, or extensive "hotspots" of coral and/or hardbottom that are especially sensitive and important). This objective will be achieved in three stages: 1) Review of all recent, precisely geolocated bottom imagery recording not just presence but absence, abundance, size, and diversity/complexity of deepwater coral and hardbottom communities. This will result in a major improvement over the currently available presence-only summaries of exploration efforts in the region. 2) Develop predictive models that use these new data types and newly available mapping and oceanographic data to more precisely predict important areas to map and explore for discovery of sensitive deepwater coral and hardbottom areas. 3) Incorporate anticipated new mapping and exploration efforts into updated models of coral and hardbottom to provide a comprehensive, ground-truthed regional picture of the distribution, extent, abundance, and relative importance/sensitivity of these habitats.

Methods: All available benthic imagery and related data, as well as new mapping and oceanographic data, will be reviewed and processed by experts at NCCOS's Deep Coral Ecology Lab, in collaboration with original data collectors, to build a database of precisely geolocated presence/absence, abundance, size, and diversity/complexity data on deepwater coral and hardbottom communities. Using these newly available types of data, more advanced predictive models based on machine-learning algorithms (generalized additive models applied in the context of ensemble boosting) will be developed by spatial statisticians and benthic ecologists at NCCOS's Biogeography Branch. Models will be used to produce maps and GIS products, including measures of accuracy and certainty, that will be made available to guide exploration and mapping efforts as well as immediate decision-making needs. Anticipated collection of new mapping and exploration data will then be incorporated into models to both improve and ground-truth. The result will be a comprehensive, well validated region-wide map detailing characteristics of sensitive benthic habitats.

Revised Date: January 8, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Region

Title: Air Quality Impact Assessment for the Atlantic Oil and Gas Development

BOEM Information Need(s) to be Addressed: Air quality impact assessment needs to be conducted in the Atlantic Region on the Outer Continental Shelf (OCS) to examine potential oil and gas exploration, development, and production emissions impacts to the states as required under OCSLA. This information will be used by BOEM in the National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS) cumulative analysis.

Approx. Cost: (in thousands) $2,000   **Period of Performance:** FY 2016-2018

Description:
Background: The 1990 Clean Air Act Amendments (CAAA) requires the U.S. Environmental Protection Agency (USEPA) to set the National Ambient Air Quality Standards (NAAQS) for widespread pollutants from numerous and diverse sources considered harmful to public health and the environment. The law also requires the USEPA to periodically review the standards to ensure that they provide adequate health and environmental protection, and to update those standards as necessary. The USEPA has set standards for six primary pollutants and has added 1-hour nitrogen dioxide (NO_2) and 1-hour sulfur dioxide (SO_2) standards and has proposed to lower the fine particulate matter 2.5 and ozone 8-hour standards. The Outer Continental Shelf Lands Act (OCSLA) states that OCS offshore oil and gas exploration, development, and production activities cannot significantly impact the NAAQS of any state.

Photochemical modeling needs to be conducted to ensure that Atlantic Region potential OCS offshore oil and gas exploration, development, and production activities do not significantly impact the NAAQS of any state. Air quality modeling requires various input datasets, including emissions sources, meteorology, and pre-existing pollutant concentrations. This study would develop all necessary Atlantic Region OCS air quality modeling inputs and conduct photochemical modeling assessing impacts to any state.

Objectives:

- To evaluate current Weather Research and Forecasting Model (WRF) Atlantic Region datasets, if any, and develop a new Atlantic Region OCS current meteorological WRF dataset, if necessary, sufficient as input into air quality models

- To calculate a worse case Atlantic Region OCS air emissions platform and non-platform inventory with spatial allocation based on the NEPA Multi-sale 2017-2022 Scenario; including any existing or future renewable energy development

- To perform photochemical modeling assessing air quality impacts to any state from Atlantic Region OCS activities, including assessing multi-sale 2017-2022 Scenario impacts. Current non-attainment areas (DE to FL): Hillsborough Co and Nassau Co (FL) for SO2, Tampa (FL) for lead, Atlanta (GA) for PM2.5 and 8-hour ozone, Chattanooga (TN-GA-AL) for PM2.5, Charlotte-Rock Hill (NC-SC) for 8-hour ozone, Washington (DC-MD-VA) for PM2.5 and 8-hour ozone, Baltimore (MD) for PM2.5 and 8-hour ozone, Philadelphia-Wilmington-Atlantic City (PA-NJ-MD-DE) for 8-hour ozone, Martinsburg (WV)-Hagerstown (MD) for PM2.5

- To conduct visibility analysis for the Atlantic Region Class I areas (DE to FL): Cohotta Wilderness Area (GA), Okefenokee Wilderness Area (GA), Wolf Island Wilderness Area (GA), Cape Romain Wilderness (SC), Great Smoky Mountains National Park (NC), Joyce Kilmer-Slickrock Wilderness Area (NC), Linville Gorge Wilderness Area (NC), Shining Rock Wilderness Area (NC), Swanquarter Wilderness Area (NC), James River Face Wilderness (VA), Shenandoah National Park (VA), St Marks Wilderness Area (FL)

- To conduct PSD Increment Analysis and Conformity Determinations, as needed

Methods: Photochemical modeling using the Community Multi-scale Air Quality model (CMAQ) and/or the Comprehensive Air quality Model with extensions (CAMx) is needed to estimate potential impacts of offshore OCS air emissions to the air quality of any state. For photochemical modeling, multi-sale 2017-2022 scenario emissions must be developed, all onshore and offshore emissions must be preprocessed, WRF meteorological datasets should be compiled, resolution grids over the Atlantic Region with finer, nested grids over non-attainment areas and the Class I areas should be established, and any other dataset needed should be compiled to run the photochemical model. The modeling results would assist in defining the multi-sale 2017-2022 scenario impacts, if any, of all oil and gas development sources induced by OCS activity, including the formation of secondary fine particulate matter (PM2.5) and ozone, plus visibility impacts analysis for Class I areas. Dispersion modeling (AERMOD-COARE and/or CALPUFF) will be conducted, if needed, for any PSD Increment Analysis and Conformity Determinations.

Revised Date: January 12, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Regions

Title: Development of an Atlantis Model for the Mid and South Atlantic OCS to Facilitate Strategic Planning and Cumulative Impact Evaluation

BOEM Information Need(s) to be Addressed: The purpose of this project is to create a baseline ecosystem model of the Mid- and South- Atlantic using the Atlantis Ecosystem Model. This multipurpose model can provide BOEM with critical information about (1) the effects of oil spills due to the recent development of spatial forcing functions that can model the fate of oil in the environment and (2) the cumulative effects of OCS development on the ecosystem through the manipulation of module inputs. Both can be critical for the safe and responsible exploration and development of offshore energy resources. This model will provide compliance with the Magnuson-Stevens Fishery Conservation and Management Act, the Endangered Species Act, and the National Environmental Policy Act, especially with respect to fisheries, protected resources, and essential fish habitat in the region. In addition to meeting BOEM's needs, this model will be used for NMFS habitat and living marine resource management in their ongoing efforts to incorporate habitat and ecosystems information in fisheries management planning. As a cooperative project, NMFS will provide funding as a match for the project and enable the leveraging of existing Atlantis models for the Atlantic Northeast and the Chesapeake Bay to build the new model.

Approx. Cost: (in thousands) $3,600   **Period of Performance:** FY 2016-2018

Description:
Background: The Atlantis Ecosystem Modeling System is designed as a tool for strategic management of coastal and ocean resources. It is designed to simulate the physics, biogeochemistry, and food webs of ocean ecosystems and the stressors that influence those systems. Atlantis simulates the biophysical elements of the system and allows users to run different scenarios with changes in stressor levels to determine the response of the system to those stressors. Scenarios can be run with single stressor or multiple stressor changes (i.e., cumulative effects of multiple stressors). In addition to the strategic planning aspect, this model would increase BOEM's ability to address cumulative effects of OCS development.

Atlantis is a modular model based around having multiple alternative sub-models to represent each step in the management strategy and adaptive management cycles. The biophysical and fisheries sub-models are the most extensive. The core model is a deterministic biophysical sub-model that is spatially-resolved in three dimensions using a map made up of boxes and prism-like layers. This model tracks the nutrient (e.g., nitrogen and silica) flows through the main biological groups in the modeled ecosystem. The primary ecological processes considered in the model are consumption, production, waste production and cycling, migration, predation, recruitment, habitat dependency,

and mortality. Atlantis also features a detailed resource utilization model. This model deals with the impact of pollution, coastal development and broad-scale environmental change, but is focused on the detailed dynamics of fishing fleets. Additional sub-models of the resource utilization model can be implemented to include explicit handling of economic drivers, compliance decisions, exploratory fishing and other complicated real world concerns.

Objectives: (1) Develop a functioning Atlantis Biophysical model representing the Mid and South Atlantic U.S. coastal shelf. (2) Create a functioning Atlantis Resource Utilization model representing key commercial and recreational fisheries of the region. (3) Explore Management Strategy Evaluations (MSE) using Atlantis to enable exploratory evaluation of the potential impacts of ocean energy resource utilization and climate change on key fisheries, protected species and essential fish habitat.

Methods: Depending on the available funds, the spatial extent of the model and the number of modules must initially be determined. Options include reducing the scale to just the Mid-Atlantic region, reducing the quantity or complexity of input modules, or some combination of both. Scale reduction could potentially reduce costs by 20% per year; however, this would reduce the quality and broad-scale applicability of this technique. Since this is a collaborative project NOAA would also have the ability to provide additional funding, and have indicated that this is a possibility.

#1 - (A) The model spatial structure will be developed in consultation with BOEM, NMFS and Fishery Management Councils to ensure capture of key geographic features. (B) A hydrodynamic model of the region will be used to provide physical forcing on the system. Climate forcing will be incorporated in this base model. (C) The biological/ecological module will be developed with partners to ensure key fisheries species, protected species, and essential fish habitat are represented.

#2 - (A) Federal and state fisheries data will be reviewed and used to parameterize model. (B) For living marine resources, data on fishing gear type, seasons, and catch will be aggregated to fit the Biophysical model structure and enable simulation for management strategy evaluation. (C) Data on offshore energy siting and reserves will be included to enable simulation for management strategy evaluation.

#3 – The scenarios for MSE will be developed in consultation with BOEM.

NMFS personnel have extensive experience with ecosystem models around the country. The primary ecosystem modeling tools used by NMFS are the Atlantis and Ecopath with Ecosim (EwE) software. Atlantis and EwE models have been developed for the North East U.S. coastal shelf and Chesapeake Bay, and EwE models exist for the Mid and South Atlantic. These existing models and NMFS expertise will guide development of the proposed models. The EwE models will inform the biophysical model input as they provide lists of the major regional fisheries and protected species groups and initial biomass estimates. Besides the working model and sub-routines, deliverables include a series of reports that provide potential outcomes and cumulative impacts to resources under the multiple scenarios developed jointly between BOEM and NOAA.

Revised Date: April 22, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Region

Title: *Deepwater Atlantic Habitats II*: Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities

BOEM Information Need(s) to be Addressed: This study represents a follow-on to the inter-agency Mid-Atlantic Canyons study which provided important new information on deep water communities, including discoveries related to *Lophelia* and methane chemosynthetic community distributions. With potential oil and gas activity on the Mid and South Atlantic OCS, BOEM now requires follow-on deepwater information in an expanded footprint including further into the southeast Atlantic. Study results will help to define mitigations and need for avoidance of hard bottom areas and associated sensitive communities in deep water. New areas will include recently discovered gas seep areas to determine extent of chemosynthetic community development. New baseline habitat information will inform Essential Fish Habitat consultations, development of mitigation measures for potential oil and gas activities, and NEPA sections on benthic communities.

Approx. Cost: (in thousands) $4,000   **Period of Performance:** FY 2017-2020

Description:
Background: A successful paradigm for deep water research through inter-agency partnerships has been established through several exploration programs, including the Mid-Atlantic Canyons Study. This particular study involved partnership between BOEM, NOAA Office of Exploration and Research (OER), and USGS and was established to focus on the identification, biodiversity, ecology, and food-web dynamics of benthic communities associated with canyon, coral, and hardground habitats. Notable discoveries which occurred during the cruises included documentation of the first *Lophelia pertusa* colonies in these canyons and presence of methane seeps and very large associated chemosynthetic communities on the Atlantic OCS. With the recent opening of the Mid and South Atlantic to potential oil and gas activities, expanded deepwater exploration is required which also incorporates areas in the southeast Atlantic, including south of Cape Hatteras. While the area south of Cape Hatteras contains some of the most significant deepwater coral habitat in U.S. waters, much of this region still remains unexplored and requires further research and mapping to adequately characterize sensitive habitat and guide management actions for protecting these regions, including for undiscovered communities associated with corals, canyons, and seeps in this region.

Objectives: This study will provide new baseline information on habitat distributions and functioning in the Southeast Atlantic, including characterization, extent, abundance, and relative importance/sensitivity of these habitats. The study will also perform process-oriented research to understand the function of these habitats for

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276

biodiversity and managed species, as well as an understanding of environmental conditions that result in observed distributions of high-density hard bottom communities that are sensitive to impacts from oil and gas development activities. The study will also assess connections between benthic productivity and productivity in the overlying water column to develop a better understanding of whole ecosystem functioning and the overall role of unique benthic habitats.

Methods: This project will employ a range of interdisciplinary methods to characterize and sample select benthic communities and related environmental factors, including in the pelagic zone. As in the Mid-Atlantic Canyons study, National Ocean Partnership Program (NOPP) sponsorship and inter-agency collaboration and partnering is anticipated with USGS and NOAA OER for vessels and submergence facilities (i.e., submersibles and/or ROVs and AUVs). The study will require the use of sophisticated submergence facilities capable of high-resolution bottom imagery as well as extensive sample collection. Large-scale mapping will be required to define substrate type and distribution of significant hard bottom areas in deep waters. Focused studies on selected communities will collect samples as well as incorporate process studies to determine community composition, complexity and sensitivity to impacts. Study results will be made available in GIS layers for use by BOEM analysts, in the peer-reviewed literature, and in a final report providing links to all collected datasets.

Revised Date: January 12, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Region

Title: Mid and South Atlantic Ocean Modeling

BOEM Information Need(s) to be Addressed: As part of the NEPA process, BOEM uses the Oil Spill Risk Analysis (OSRA) model to assist in evaluating oil spill risks to the environment from offshore oil and gas exploration and development activities. This study will result in an ocean model that will be used to simulate surface ocean current fields that will be input into the OSRA model for simulating spill trajectories and producing probabilistic estimates of oil spill occurrence and contact to biological and economic resources.

Approx. Cost: (in thousands) $1,250   **Period of Performance:** 2017-2019

Description:
Background: To perform risk analysis of spills related to oil and gas exploration and development activities BOEM uses the OSRA model to produce probabilistic estimates of oil spill occurrence and contact to environmental resources. The OSRA model requires knowledge of historical records of oil spills, winds and ocean currents. Numerical ocean models can be used to simulate surface ocean currents using a variety of observational data. A number of ocean models are already in use in the Mid and South Atlantic areas. These models have been used for many years and have undergone a great deal of scrutiny. Over the years many improvements have been made and a number of sensitivity calculations have been performed. This study will identify an appropriate model to perform hindcast simulations of ocean currents and winds required to work within the OSRA model.

Objectives: The main goal of this study is to identify a reliable and proven ocean model that can provide reliable modeled surface ocean currents that can be used for calculating spill trajectories using the BOEM OSRA model. The model should be capable of simulating surface ocean currents for short time intervals (hours) over extended periods (years). For example, the GOM region uses a 3-hour interval over a 15-year period.

Methods: This study will use an ocean model to perform hindcast simulations of surface ocean currents. The model will include detailed information on ocean currents and wind fields. Validation of the model by comparing field observations (i.e. current meters, drifting buoys, etc.) to model output will also be performed.

Partnerships will be sought with other federal agencies and/or universities that share common goals. For example, the Princeton Ocean Model has been used previously to provide input to the OSRA model. Partnerships will provide leveraged funding, avoid duplication of effort and may support additional ongoing projects.

Revised Date: January 12, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid- and South Atlantic

Administered By: Gulf of Mexico OCS Region

Title: Environmental Justice (EJ) Baseline for the Mid-and South Atlantic Regions: Hazard-risk Assessment of Low-income Minority Coastal Populations near Existing and Projected Onshore Oil and Gas Infrastructure

BOEM Information Need(s) to be Addressed: BOEM must identify any disproportionate impacts of BOEM managed activities on minority or low-income populations to fulfill the requirements of Executive Order 12898 (59 FR 7629). Executive Order 12898 outlines Federal Agency responsibilities including the review of Federal activities and the implementation of measures to ensure Federal Programs are conducted in a manner that achieves Environmental Justice (EJ). This study would identify minority and low-income populations in the Mid-and South Atlantic coastal areas (Maryland to Georgia), gather information about oil and gas infrastructure and systematically classify the hazard of infrastructure types. The information would be utilized to prepare EJ analyses for National Environmental Policy Act (NEPA) documents.

Approx. Cost: (in thousands) $200   **Period of Performance:** FY 2017-2019

Description:
Background: The Outer Continental Shelf (OCS) region in the Mid- and South Atlantic has recently been identified as an area where G&G oil and gas surveying activities will be reinitiated after a more than 30 year hiatus and an area that is being considered for a future lease sale as identified in the 2017-2022 Oil and Gas Leasing, Draft Proposed Program (DPP) from the Maryland to Georgia Coast. With the reinitiation of G&G oil and gas surveying activities and inclusion in the 2017 to 2022 DDP of portions of the Atlantic OCS there is the potential for the identification of oil and gas resources and subsequent oil and gas exploration and development. Environmental assessment, coordination and consultation including EJ assessments must be completed prior to implementing major Federal Actions, including oil and gas development, to meet environmental compliance requirements.

The proposed study would compile U.S. Census and other data to characterize coastal populations, identify and map minority or low-income populations in Mid–and South Atlantic coastal communities (Maryland to Georgia) and identify and map oil and gas infrastructure. GIS-based techniques would be used to compare the location of these populations with existing and possible future oil and gas infrastructure. The study would evaluate the potential hazard (negative impact) of existing and possible new development infrastructure on specific populations. The study would utilize hazard assessment techniques similar to those developed in OCS Study MMS 2003-038 Environmental Justice Considerations in Lafourche Parish, Louisiana, and utilize information about existing and projected onshore oil and gas infrastructure in the Mid-

Atlantic as outlined in OCS BOEM Report 2014-657 Onshore Oil and Gas Infrastructure to Support Development in the Mid-Atlantic OCS Region.   In previous studies OCS related environmental hazards were evaluated based on frequency of occurrence, types of activities: OCS transportation corridors, refineries and gas producing plants, pipelines, pumping stations and oil storage facilities and shipyards and shipbuilding yards and using hazards of place models which identified zones of biophysical, social and place vulnerability.

 Information generated by this study would be utilized to conduct EJ assessments for any future Mid-and South Atlantic oil and gas exploration and development leasing proposals identified in the DDP (coast of Maryland south to Georgia coast).

Objectives: The objectives of this study are to:

- Identify existing protected populations through the compilation of demographic information (U.S. Census and other sources).

- Use GIS techniques to map demographic information to develop distribution of low-income or minority populations in Mid- and South Atlantic coastal areas.

- Identify and systematic classify existing onshore oil and gas infrastructure and areas that support oil and gas activities by hazard severity to be used for future EJ analysis in this region. Identify locations suitable for future onshore oil and gas infrastructure or other support activities. Map existing and projected onshore infrastructure.

- Use GIS techniques to identify overlap between low-income and minority populations and onshore infrastructure or associated zones or vulnerability.

Methods: This study would use GIS techniques to map the overlap of low-income and minority population in Mid-and South Atlantic Coastal Areas with existing and projected onshore oil and gas infrastructure or larger hazard zones identified using a hazards of place models.   Statistical techniques including contingency analysis, discriminant analysis (block level and block group level) and multiple regression analysis (chi squared, discriminant analysis, ANOVA etc.,)   or other statistical techniques could be used to examine proximity of low-income, minority populations, and other populations OCS infrastructure potential hazards including consideration of the degree or severity of the hazard, to test relationships between racial categories and proximity to OCS-related facilities and identify factors to distinguish between groups that reside around hazardous locations. Information previously developed in OCS BOEM Report 2014-657 Onshore Oil and Gas Infrastructure to Support Development in the Mid-Atlantic OCS Region would support the study. Methodologies would follow techniques developed in OCS Study MMS 2003-038 Environmental Justice Considerations in Lafourche Parish, Louisiana.

Revised Date: May 6, 2015

Environmental Studies Program: Studies Development Plan FY 2016-2017

Study Area(s):   Mid and South Atlantic OCS

Administered By: Gulf of Mexico OCS Region

Title: Baseline Geochemical Characterization of the Mid and
                         South Atlantic Outer Continental Shelf

BOEM Information Need(s) to be Addressed: The Outer Continental Shelf Lands Act (OCSLA) requires that if blocks on the Atlantic OCS are to be leased in the future, BOEM must conduct baseline studies of the Atlantic OCS prior to that. This study is designed to meet that requirement by determining the baseline geochemical state of Atlantic OCS waters and sediments in all areas likely to be included in offshore oil and gas development as well as a few geochemically similar areas not likely to be developed. Some examples of what geochemical information is required are metal and polyaromatic hydrocarbon (PAH) concentrations as well as basic information such as salinity and pH. The results of the study will be critical for informing Environmental Impact Statements for any proposed Atlantic OCS actions as this type of data describes the current environment and allows BOEM to reexamine these parameters later to determine possible effects of offshore oil and gas activities on the environment. Thus, this study may also serve as a stepping stone for future, more focused geochemical studies or monitoring efforts once activities have begun on the Atlantic OCS and could also compliment any proposed biological characterization studies since the biota would reside in the waters and sediments of the Atlantic OCS.

Approx. Cost: (in thousands) $7,000   **Period of Performance:** FY 2017-2021

Note: The cost can be decreased if ship time is able to be leveraged with other Atlantic efforts. Also, the study could be done in phases or focused on a limited area to decrease initial cost output.

Description:
Background: OCSLA requires that "The Secretary shall conduct a study of any area or region included in any oil and gas lease sale or other lease in order to establish information needed for assessment and management of environmental impacts on the human, marine, and coastal environments of the outer Continental Shelf and the coastal areas which may be affected by oil and gas or other mineral development in such area or region." Furthermore, such studies are required to be conducted before leasing is conducted in the area. Though the Atlantic OCS has not had significant oil and gas development, it is significantly populated and developed. Thus, the current state of the Atlantic OCS cannot be assumed to be pristine.   A literature search that synthesizes high quality, relevant data from areas where there is potential for oil and gas exploration and development is a necessary first step to meet BOEM's obligations. Since BOEM needs comparable regional data, it is highly likely that significant data gaps will be revealed through the initial literature search and thus a second step to collect further baseline data uniformly in all areas of interest will be necessary to meet BOEM's obligations. Baseline studies are critical in determining the contribution of offshore oil

and gas activities to the state of the waters and sediments of the Atlantic OCS. Since biota in the Atlantic OCS reside within the waters and sediments of the Atlantic OCS, this information will inform biologically oriented baseline studies as well. Ideally, this study would be one of several interrelated studies to gather baseline data on all appropriate resources that must be evaluated in an EIS for activities proposed in the Atlantic OCS.

In addition to a standard report, the products of this efforts should include at least one peer-reviewed paper, a Reference Manager and Endnote readable database of references used, and any electronic copies of references or data used as allowed by copyright law.

Objectives: The objective of this study is to determine the current state of the waters and sediments of the Atlantic OCS, through both literature searches and direct geochemical analysis, before any oil and gas exploration or production take place. Furthermore, this study will compare the resulting data to available water and sediment quality guides issued by the Environmental Protection Agency and the National Oceanic and Atmospheric Administration. The results of this study will then serve as a baseline for any future geochemical characterization studies once OCS oil and gas activities have begun.

Methods: The first step in this study will be to conduct a literature review to examine what is known about the waters and sediments of the Atlantic OCS in regions of possible oil and gas development as well as in related regions not slated for oil and gas development. Then the study will determine what additional data is necessary to fill in gaps in order to have a uniform regional examination of the state of the Atlantic OCS waters and sediments and collect that data. Specific variables that will be examined by geochemical methods or searched for in the literature may include, but are not limited to metal (e.g., Cd, Hg, Cr, Pb, etc...), PAHs, total organic carbon, petroleum hydrocarbon indicators (to differentiate oil from sunken vessels from future OCS oil and gas activities), and hydrocarbon concentrations in the water column, pore water, and sediments. Nutrient and NORM characterization could also be considered as time and funding permit. To accompany these analytical values, other measurements such as pH, Eh (or dissolved oxygen), salinity, and particle size analysis of the sediments should be conducted in order to get a more complete picture of the geochemical environment. All of the data will be compared to "health" guidelines to evaluate the condition of the Atlantic OCS. Sound reference and data management practices including clear metadata standards are expected. It is also expected that the study will follow accepted geochemical sampling and analytical methods including all necessary quality control measures and statistical analysis to produce the desired data. Ideally, ship time for this study could be leveraged with other baseline studies (e.g., benthic biology baseline studies and/or archeological studies) to reduce the cost of this study, but the study could be done in phases or in one geographic area at a time to manage costs. The initial literature review should help determine the minimal amount of samples needed to allow for the sampling locations to serve as possible monitoring locations for future studies after oil and gas activity begins.

Revised Date: January 12, 2015

APPENDIX III: ABBREVIATIONS AND ACRONYMS

AMBON	Arctic Marine Biodiversity Observation Network
ArcSEES	Arctic Science, Engineering and Education for Sustainability
ARCWEST	Arctic Whale Ecology Study
ASAP	Atlantic Sand Assessment Project
AZFP	Algae, Zooplankton, Fish Profilers
bbls	Barrels
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BSEE	Bureau of Safety and Environmental Enforcement
CF	climate and forecast metadata conventions
cf	cubic feet
COOP	Cooperative Agreement
DWH	*Deepwater Horizon*
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DRAA	Disaster Relief Appropriation Act
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ESA	Endangered Species Act
ESP	Environmental Studies Program
ESPIS	Environmental Studies Program Information System
ESP-PAT	Environmental Studies Program - Performance Assessment Tool
FY	Fiscal Year
G&G	Geological and Geophysical
GIS	Geographic Information System
GNOME	General NOAA Oil Modeling Environment
GOM	Gulf of Mexico
GOMR	Gulf of Mexico Region
GOMA	Gulf of Mexico Alliance
HDCC	Human Dimensions of Climate Change
HCD	Habitat Conservation Division
HPPG	High Priority Performance Goal
IARPC	Interagency Research and Policy Committee
IOPER	International Offshore Petroleum Environmental Regulators

IPCC	International Panel on Climate Change
LEO	Local Environmental Observer Network
LME	Large Marine Ecosystems
MARCO	Mid-Atlantic Regional Council on the Ocean
MARES	Marine Arctic Ecosystem Study
MARINe	Multi-Agency Rocky Intertidal Network
MHK	marine hydrokinetic
MIDAS	Marine Integrated Decision Analysis System
MIMES	Multi-scale Integrated Model of Ecosystem Services
MMP	Marine Minerals Program
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NAS	National Academy of Science
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOP	National Ocean Policy
NOPP	National Oceanographic Partnership Program
NOSB	National Ocean Sciences Bowl
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
NREL	National Renewable Energy Laboratory
NROC	Northeast Regional Ocean Council
NSL	National Studies List
OCS	Outer Continental Shelf
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OCSLA	Outer Continental Shelf Lands Act
OEP	Office of Environmental Programs
OMB	Office of Management and Budget
ONR	Office of Naval Research
OREP	Office of Renewable Energy Programs
OSRA	Oil Spill Risk Analysis
OSRP	Oil Spill Response Plans
OSTP	Office of Science and Technology
PDF	portable document format
PMEC-SETS	Pacific Marine Energy Center-South Energy Test Site
PRISM	Pacific Regional Investigation Survey and Monitoring (formerly Pacific Rocky Intertidal Survey and Monitoring)

RFP	Request for Proposals
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunity and Revived Economics of the Gulf States Act of 2011
RPB	Regional Planning Body
RSM	Regional Sand Management
RODEO	Real-time opportunity for Development Environmental Observation
SCCWRP	Southern California Coastal Water Research Project
SDP	Studies Development Plan
SMWG	Sand Management Working Group
SOST	Subcommittee for Ocean Science and Technology
TAP	Trajectory Analysis Planner
UF	University of Florida
U.S.	United States
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
WEAs	Wind Energy Areas