

# BOEM

BUREAU OF OCEAN ENERGY MANAGEMENT



## Environmental Studies Program

### Studies Development Plan FYs 2017-2019

# TABLE OF CONTENTS

List of Figures .....	iv
Chapter 1 Overview .....	1
1.1 Introduction, Purpose, and Vision .....	1
1.1.1 Authorities .....	3
1.1.2 Responsibilities .....	4
1.2 Overview of BOEM’s ESP Direction and Research Support .....	5
1.2.1 Use-inspired Science .....	5
1.2.2 Credibility, Integrity, Relevance, and Cost .....	6
1.2.3 Partnering and Leveraging Efforts .....	7
1.2.4 Information Management and Dissemination .....	7
1.2.5 Outreach and Education .....	8
1.3 Programmatic Objectives .....	8
1.3.1 Ecosystem-Based Management .....	9
1.3.2 Arctic Marine Science and Climate Change .....	9
1.3.3 Ocean Observation and Modeling .....	9
1.3.4 Data Accessibility and Management .....	9
1.3.5 Support Environmental Assessments and Consultations .....	10
Chapter 2 National Program .....	11
2.1 Introduction .....	11
2.2 Conventional Energy Science Strategy .....	11
2.2.1 Biological .....	12
2.2.2 Protected Species .....	12
2.2.3 Fates and Effects .....	12
2.2.4 Meteorology and Air Quality .....	12
2.2.5 Archaeological Resource Preservation .....	13
2.2.6 Information Management & Integrated Studies .....	13
2.3 Renewable Energy Science Strategy .....	13
2.4 Marine Minerals Science Strategy .....	13
2.4.1 Fates and Effects .....	14
2.5 Future Plans .....	15
2.5.1 ESP Programmatic Plans .....	15
2.5.2 Marine Minerals Future Plans .....	16
Chapter 3 Alaska Studies .....	18

3.1	Introduction .....	18
3.2	Conventional Energy Science Strategy .....	23
3.2.1	Biological .....	24
3.2.2	Protected Species .....	25
3.2.3	Physical Oceanography .....	25
3.2.4	Fates and Effects .....	26
3.2.5	Meteorology and Air Quality .....	26
3.2.6	Social Sciences and Economics .....	27
3.2.7	Information Management & Integrated Studies .....	28
3.3	Renewable Energy Science Strategy .....	28
3.3.1	Biological .....	28
3.4	Marine Minerals Science Strategy .....	29
3.5	Future Plans .....	29
3.5.1	Conventional Energy Future Plans .....	29
3.5.2	Renewable Energy Future Plans .....	32
Chapter 4	Gulf of Mexico Studies .....	33
4.1	Introduction .....	33
4.2	Conventional Energy Science Strategy .....	36
4.2.1	Biological .....	37
4.2.2	Protected Species .....	38
4.2.3	Fates and Effects .....	38
4.2.4	Meteorology and Air Quality .....	39
4.2.5	Social Sciences and Economics .....	39
4.2.6	Archaeological Resource Protection .....	41
4.3	Renewable Energy Science Strategy .....	42
4.3.1	Information Management & Integrated Studies .....	42
4.4	Marine Minerals Science Strategy .....	42
4.5	Future Plans .....	43
4.5.1	Conventional Energy Future Plans .....	43
4.5.2	Marine Minerals Future Plans .....	46
Chapter 5	Pacific Studies .....	49
5.1	Introduction .....	49
5.2	Conventional Energy Science Strategy .....	54
5.2.1	Fates and Effects .....	55

5.3	Renewable Energy Science Strategy .....	56
5.3.1	Protected Species .....	57
5.3.2	Physical Oceanography.....	58
5.3.3	Social Sciences and Economics .....	59
5.4	Future Plans.....	59
5.4.1	Conventional Energy Future Plans .....	59
5.4.2	Renewable Energy Future Plans .....	59
5.4.3	Marine Minerals Future Plans.....	60
5.4.4	Stakeholder Outreach and Partnerships Future Plans .....	61
Chapter 6	Atlantic Studies.....	62
6.1	Introduction .....	62
6.1.1	Conventional Energy Program.....	62
6.1.2	Renewable Energy Program .....	64
6.1.3	Marine Minerals Program.....	64
6.2	Conventional Energy Science Strategy .....	65
6.2.1	Biological.....	65
6.2.2	Social Sciences and Economics .....	66
6.3	Renewable Energy Science Strategy.....	67
6.3.1	Biological.....	67
6.3.2	Social Sciences and Economics .....	70
6.3.3	Information Management & Integrated Studies .....	70
6.4	Marine Minerals Science Strategy .....	70
6.4.1	Biological.....	71
6.5	Future Plans.....	72
6.5.2	Conventional Energy Future Plans .....	72
6.5.3	Renewable Energy Future Plans .....	72
6.5.4	Marine Minerals Future Plans.....	73
References	.....	74
Appendix I.	Tables of Proposed Studies for FY 2017 and FY 2018.....	75
Appendix II.	FY 2017–FY 2018 Study Profiles Organized by Region.....	83
Appendix III.	Abbreviations and Acronyms.....	280

## LIST OF FIGURES

Figure 1. Pie chart of ESP expenditures between FY 2011–2015 by vendor type.....	2
Figure 2. Pie chart of ESP expenditures between FY 2010–2015 by discipline. ....	3
Figure 3. Alaska OCS Region Planning Areas.....	19
Figure 4. Cook Inlet Planning Area. ....	20
Figure 5. Chukchi Sea Planning Area.....	21
Figure 6. Beaufort Sea Planning Area. ....	22
Figure 7. GOM OCS Planning Areas. ....	33
Figure 8. Aerial photograph of Caminada Headland construction, September 6, 2013. Photo credit: Patrick M. Quigley (www.gulfcoastairphoto.com). ....	35
Figure 9. Complex competing use challenges with respect to oil and gas platforms and pipelines in the GOM. ....	36
Figure 10. Oil and Gas Leases and Facilities in the Pacific Region.....	50
Figure 11. OCS Renewable Energy Projects in the Oregon OCS. ....	51
Figure 12. OCS Renewable Energy Projects in the Hawai‘i OCS. ....	52
Figure 13. OCS Renewable Energy Projects in the California OCS. ....	53
Figure 14. Atlantic OCS Planning Areas for Renewable Energy.....	63
Figure 15. Before and after Hurricane Sandy storm damages (Seaside Heights, New Jersey)..	65

# CHAPTER 1 OVERVIEW

## 1.1 Introduction, Purpose, and Vision

The Department of the Interior's (DOI's) Bureau of Ocean Energy Management (BOEM) is responsible for managing the development of the Nation's offshore energy and mineral resources in an environmentally and economically responsible way. These resources include oil and gas; wind, waves, and current energy; sand, gravel, and other minerals. BOEM manages approximately 2.3 billion acres of the Outer Continental Shelf (OCS)—the continental shelf located beyond State waters—including about 1.7 billion acres offshore the continental United States and about 600 million acres offshore the State of Hawai'i. Currently, over 27 million of these acres are actively leased by BOEM (BOEM 2016) which provide for about 5 percent of the Nation's natural gas production and about 18 percent of domestic oil production.

Environmental stewardship is at the core of BOEM's mission. Diverse Federal laws task BOEM with protecting the marine, coastal, and human environments, including the OCS Lands Act (OCSLA), the National Environmental Policy Act (NEPA), the Marine Mammal Protection Act (MMPA), and others. BOEM utilizes the best-available science to support sound policy decisions and manage OCS resources. Since 1973, Congress has funded an Environmental Studies Program (ESP), mandated after 1978 by Section 20 of OCSLA, to produce research needed for decision support. BOEM facilitates top-quality research by talented scientists from a range of disciplines that is targeted to support policy needs and priorities.

The BOEM Studies Development Plan (SDP) is a strategic planning document released annually by the ESP. The SDP is used internally to outline the Program's scientific direction, identify knowledge gaps, and prioritize research for the upcoming two fiscal years (FYs). All regional offices provide substantial input and critical review of the document. The information in the SDP is used to formulate annual National Studies Lists (NSLs) that describe ESP projects eligible for funding in a given FY. Proposed studies within the SDP are peer-reviewed by BOEM subject matter experts (SMEs). 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 2017 or FY 2018 are included in Appendix I, and the study profiles for each region are included in Appendix II. All studies proposed in this SDP are subject to the availability of funds. Study needs may be adjusted after the release of this document to respond to shifting priorities, emerging information needs, and the ESP budget. This document is also a critical communication tool for the scientific community and other external stakeholders. 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 website is provided by the Environmental Studies Program Information System (ESPIS) at <http://marinecadastre.gov/espis/>.

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 and monitoring from energy and mineral development. The ESP funds are currently dispersed for defined projects through three vehicles: interagency agreements (IAs) 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 best value to the government with those objectives.

Between 2011 and 2015, 41 percent of funds went to Federal agencies (24 percent to the National Oceanic and Atmospheric Administration [NOAA] alone); 31 percent to academic institutions; 23 percent to private research organizations; 3 percent to State government agencies; and 2 percent to other researchers (Figure 1). The subject matter allocation of funds over FY 2010–2015 was 28 percent marine mammals and other protected species; 28 percent habitat and ecology; 16 percent physical oceanography; 9 percent social sciences and economics; 10 percent fate and effects of oil spills; 5 percent information management; and 4 percent air quality (Figure 2).

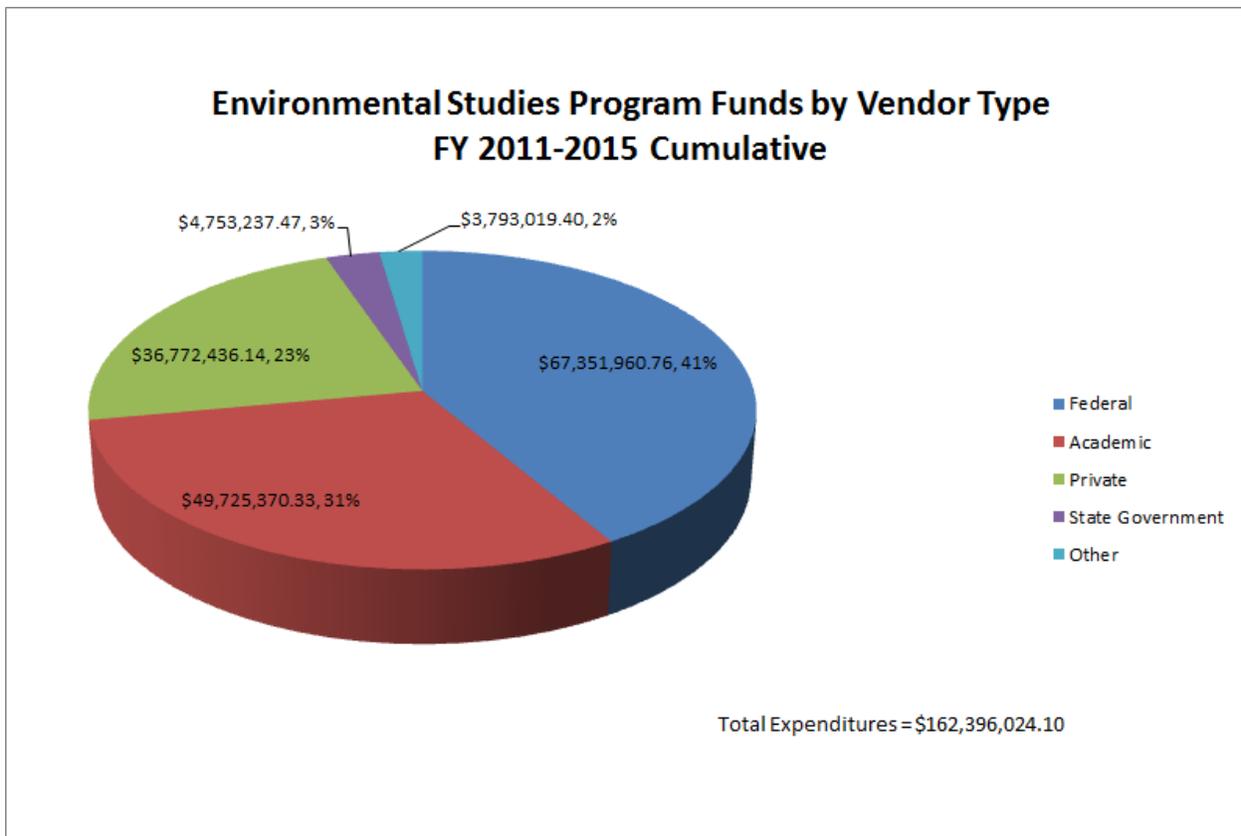


Figure 1. Pie chart of ESP expenditures between FY 2011–2015 by vendor type.

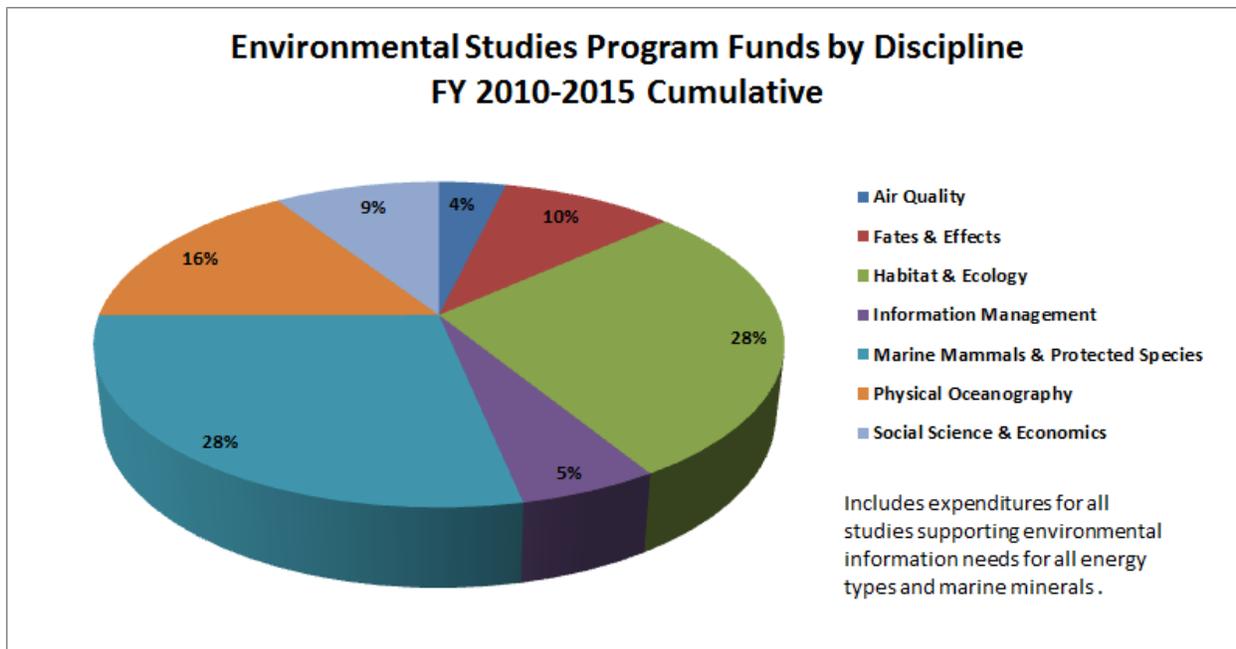


Figure 2. Pie chart of ESP expenditures between FY 2010–2015 by discipline.

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, an independent group of experts established by the Secretary of the Interior under the Federal Advisory Committee Act. In 2015, BOEM replaced this committee with a National Research Council (NRC) standing Committee on Offshore Science and Assessment (COSA). The COSA convenes experts from academia, industry, and other organizations to provide independent, technical input on issues of interest to BOEM’s environmental science and assessment responsibilities. BOEM is excited about this new partnership with the NRC and the strategic science direction it can provide for the Bureau’s environmental research.

### 1.1.1 Authorities

The ESP was initiated in 1973 as a means to gather and synthesize environmental science and socioeconomic information to support decision-making concerning offshore natural resource development. OCSLA, as amended in 1978 and 2005, establishes policies for developing OCS natural resources—including oil, gas, renewable energy, and non-energy minerals—and for protecting the marine, coastal, and human environments from effects of development. Section 20 of OCSLA authorizes the ESP and establishes three general goals for the program:

- Baseline Studies – 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;

- Fate and Effects Studies – 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,
- Monitoring Studies – 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 for designing studies to identify the causes of these changes.

### ***Conventional Energy***

OCSLA requires the DOI to prepare a 5-year program specifying the size and location of areas for Federal offshore oil and natural gas leasing and assess 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 addresses OCS oil and gas exploration, development, and production in the Gulf of Mexico (GOM), Pacific, and Alaska (BOEM 2011). BOEM is currently developing the 2017–2022 Five Year Oil and Gas Program which outlines the size, timing, and location of leasing activity for those years. The Proposed Program was released on March 15, 2016 (<http://www.boem.gov/Five-Year-Program-2017-2022/>) and includes lease areas in the GOM and Alaska. No conventional energy lease sales are scheduled in the Pacific or Atlantic in the 2017–2022 Program.

### ***Renewable Energy***

The Energy Policy Act of 2005 (EPAAct; P.L. 109-58) amended OCSLA to add renewable energy to DOI's (and BOEM's) development and environmental protection responsibilities. 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 U.S. 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 also assigns DOI (delegated to BOEM) responsibility for developing non-energy minerals on the OCS, such as sand, and providing related environmental protection. Section 8(k) of OCSLA sets forth specific requirements for this activity. 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 OEP conducts environmental reviews, including 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, and it creates official maps and geographic information system (GIS) data.

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

The MMP is comprised of Headquarters staff in the Office of Strategic Resources and OEP based in Sterling, Virginia, and GOM 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. There has historically been no interest in leasing sediment from the Pacific OCS due to the nature of the often rocky and high profile coast, which makes nourishment less prescriptive, coupled with the relative depth of the OCS, which is often below depths that the standard industry equipment is designed to dredge. Interest in the Pacific OCS may materialize in the future as eustatic sea level rise, and El Niño weather events put pressure on coastal infrastructure, and as industry capabilities expand. The only MMP interest along the OCS off of Alaska has been in competitive leasing for gold. This interest was fleeting, but it may resurface in the future. 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. OEP contributes to this effort by providing critical environmental research and preparation of rigorous environmental assessments for proposed development-related activities.

## **1.2 Overview of BOEM's ESP Direction and Research Support**

### **1.2.1 Use-inspired Science**

BOEM embraces the concept of "use-inspired" science in developing ESP studies. "Use-inspired" means an approach that integrates the quest for fundamental knowledge with the objective to inform decisions on practical problems. Scientific research that is use-inspired is

designed with a view to advance broader fundamental understanding of phenomena being examined together with providing answers to specific questions needed for management decisions.

National attention has been directed towards the ESP's performance measures and accountability. The ESP Performance Assessment Tool (ESP-PAT) 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. The ESP-PAT ensures the ESP fulfills its mission of providing the best possible scientific information for making decisions concerning our offshore resources. Under DOI's Renewable Energy High Priority Performance Goal (HPPG), ESP also reports the percentage of environmental studies that support renewable energy information needs (including hybrid studies that benefit renewables) in a given FY. In FY 2015, the ESP exceeded the established targets for ESP-PAT and HPPG metrics.

### **1.2.2 Credibility, Integrity, Relevance, and Cost**

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 mission relevance and scientific merit. 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. Cost is also a factor.

#### ***Scientific Integrity Policy***

The DOI'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 assessing 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 Final Information Quality Bulletin for Peer Review (EOP 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.

### 1.2.3 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), NOAA, and the United States Navy's Office of Naval Research. BOEM also has 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 Unit networks, which enable it to efficiently establish cooperative agreements with state-owned institutions.

BOEM coordinates its efforts with research 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 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, BOEM 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, high-frequency (HF) radar mapping of surface circulation 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 DOI's Partners in Conservation Award.

### 1.2.4 Information Management and Dissemination

It is ESP policy that the information it collects be made 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 presents information about ongoing and completed BOEM ESP studies. This new search tool, launched in 2015, allows text and map-based queries to find relevant study information. Study information includes downloadable electronic documents of study profiles, technical summaries and final reports, and links to associated publications and digital data. ESPIS facilitates information sharing for NEPA assessments, oil and gas and alternative energy leasing, and informing Ocean Planning initiatives. The ESPIS search tool is hosted on a shared platform with MarineCadastre.gov, which is developed in partnership with the NOAA Office for Coastal Management. ESPIS can be accessed here: <http://marinecadastre.gov/espis/>.

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 scientific information to wide audiences, and many projects have opportunities for educational components.

Information concerning ongoing research supported through the ESP is accessible at: <http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Current-Research.aspx> (BOEM 2016). 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.

### **1.2.5 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. 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. Through cooperative agreements with universities, BOEM often supports undergraduate and graduate research. 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. Eventually these students may enter government service, which might include employment at BOEM.

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. 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 disadvantaged students, which supports BOEM's goal of a diverse workforce.

## **1.3 Programmatic Objectives**

The programmatic objectives of the ESP are also informed by the ocean science and technology priorities identified by the Subcommittee for Ocean Science and Technology under the White House's Office of Science and Technology Policy (OSTP). Alignment with these higher-level priorities allows BOEM to leverage efforts and resources within the interagency. Within this prioritization framework, the ESP focuses its research in the areas of ecosystem-based management (EBM), Arctic science, understanding climate impacts on the ocean, ocean observations and modelling, data accessibility and management, and support for environmental assessments and consultations.

### **1.3.1 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 EBM<sup>1</sup> 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 predictive models, such as climate change projections, to enhance risk assessments and decision making.

### **1.3.2 Arctic Marine Science and Climate Change**

Global 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 be amplifying the potential impacts of energy exploration and development.

### **1.3.3 Ocean Observation and Modeling**

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 seeks 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.

### **1.3.4 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, the 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.

---

<sup>1</sup> 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>).

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. The MMP will leverage partner data to incorporate other considerations such as essential fish habitat (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.

### **1.3.5 Support Environmental Assessments and Consultations**

For the ESP to truly support the environmental mission of BOEM, it must ensure that the science developed through the ESP is effectively and appropriately considered when program and policy decisions are made. To accomplish this, the ESP must ensure that it is working closely and effectively with the assessment and consultation activities of the Bureau. This includes taking care to ensure that the science and information needs of the Assessment and Consultation staff throughout the Bureau are utilized as a principal driver when decisions are made about what studies activities to undertake in a given year.

The ESP must be aware of the needs, as well as the time frame within which that science or information is needed, to support the Assessment and Consultation activities of the Bureau. To that end, a significant emphasis is put on ESP staff and collaborators to ensure that this communication is happening, and that the end-users of ESP science are engaged in the development and conduct of appropriate ESP studies, and made aware when interim and final results of studies are delivered to the Bureau. This will help ensure that BOEM is using the best available and up-to-date information in their Assessment and Consultation processes.

## 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 their respective 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/](http://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

BOEM is responsible for ensuring that the effects on the natural and human environment are taken into consideration during the leasing and development of oil and natural gas on the OCS. For the 2017–2019 SDP, BOEM has developed several study profiles which address some critical knowledge gaps for the Bureau in the areas of biology, protected species, physical oceanography, air quality, economics, archaeological resource preservation, and information management. These studies will help inform decisions regarding conventional energy development on the OCS. However, these nationally-focused studies will also benefit the MMP and Renewable Program and information gathered under these studies may apply to two or more of BOEM's OCS activities. As such, while these proposed studies are included under this section, many of these topics may be applied to all three science strategies.

### 2.2.1 Biological

Understanding impacts of BOEM-regulated activities is a nation-wide priority for DES. Invasive species is an emergent area of interest for BOEM. In compliance with federal regulations, DES is seeking to determine the risk of facilitating invasive species introductions through BOEM-regulated activities. The study *Disturbed Habitat Use of Invasive Lionfish, Pterois volitans, in BOEM Permitted Activities*, is a first step towards examining how BOEM's activities may or may not contribute to invasive species propagation. The results of this study will inform future research directions as well as potential Bureau response.

### 2.2.2 Protected Species

A major focus of BOEM's research on protected species includes long-term monitoring. To support this effort, BOEM has proposed a study which will augment existing cetacean ecology research in the OCS. The study, *Demonstration Project, Integrating DNA Profiles, Genomics and Photo-Identification*, will create an integrated database of photo-identification and deoxyribonucleic acid (DNA) records to enhance analyses of population structure and dynamics.

In both the long and short term, understanding the movements of protected species on the OCS is a critical information need for BOEM. Data collected through the proposed study *Developing the Next Generation of Animal Telemetry: A Partnership To Develop Cost Effective, Open-Source, Marine Megafaunal Tracking* will assist BOEM in environmental compliance and management for all three major OCS activities. Animal telemetry can provide relevant information for NEPA, MMPA, and ESA consultations across program areas such as wind and hydrokinetic placement locations, oil/gas leasing, sand and gravel mining, and even be used to monitor impacts of climate change.

### 2.2.3 Fates and Effects

Environmental studies focused on fates and effects evaluate the physical-chemical and biological processes that affect the impacts of oil and gas drilling and production discharges, spilled oil, and oil dispersants on the OCS ecosystem. BOEM is committed to understanding the impacts of the *Deepwater Horizon (DWH) Oil Spill* of 2010 to ensure safe and environmentally responsible operations on the OCS, the long-term improvement and restoration of the Gulf Coast, and protection of other unique ecosystems of the OCS. In 2017, OEP proposes to conduct two complementary studies focused on reviewing and synthesizing the current scientific understanding of chemical, biological, physical, and social/cultural impacts related to the current state of the Gulf of Mexico ecosystem following the *DWH* spill event. The timing of these studies coincide with the recent release of the final damage assessment and the completion of the Natural Resource Damage Assessment (NRDA) process. One study will produce a *Compendium on Gulf of Mexico Oil Spill Science*. The second will support a *Symposium on Gulf of Mexico Oil Spill Science* focused information sharing and discussion of the research identified in the compendium.

### 2.2.4 Meteorology and Air Quality

OCSLA requires the Secretary of the Interior to promulgate and administer regulations that comply with the National Ambient Air Quality Standards pursuant to the Clean Air Act (42 U.S.C. 7401 *et seq.*) and to the extent that authorized activities significantly affect the air quality of any State. As required per the regulations, BOEM is tasked with air quality impact assessments both pre-lease as a cumulative analysis for NEPA impact statements, and post-lease

as an individual plan review analysis. To aid in these assessments, BOEM hopes to partner with the National Aeronautics and Space Administration's (NASA's) Atmospheric Chemistry and Dynamics Lab in the study *Use of Satellite Data for Offshore Air Quality Applications*.

### **2.2.5 Archaeological Resource Preservation**

Under the National Historic Preservation Act (NHPA), BOEM must ensure that its funded and permitted actions do not adversely affect significant historic properties. The historic properties (*i.e.*, archaeological resources) on the OCS include historic shipwrecks, sunken aircraft, buildings, and prehistoric archaeological sites that have become inundated due to the 120-meter rise in global sea level since the height of the last ice age (*ca.* 19,000 years ago). In stewardship of these historic resources, DES plans to conduct a *Nationwide Inventory and Analysis of Submerged Aircraft on the OCS*. The outcome of this study will assist with BOEM's space-use development planning and historic preservation mandates under NHPA and NEPA.

### **2.2.6 Information Management & Integrated Studies**

DES is keenly interested in expanding stakeholder outreach and including the public in its research program. Citizen Science is one mechanism to encourage participation in the scientific process, leverage efforts and data, and educate the public about BOEM needs and use of science in decision-making. The White House has made Citizen Science a priority; the Council on Environmental Quality has instructed agencies via memorandum to accelerate Citizen Science and better incorporate that science into agency decision making instructed agencies. DES is proposing a study, *Connecting Stakeholders: Incorporating Citizen Science and Crowdsourcing into Decision Making*, which will leverage public and private partnerships to unite existing Citizen Science networks. The study outcomes will be more data made available to BOEM and connection of citizens directly to the Bureau mission.

## **2.3 Renewable Energy Science Strategy**

BOEM supports the White House's goal to accelerate America's transition to clean energy sources through the development of offshore renewable energy projects on the OCS. This new activity in the marine environment requires an assessment of the potential environmental impacts to resources on the OCS. The Bureau's responsibilities include determining and evaluating the effects of OCS activities on natural, historical, and human resources and the appropriate monitoring and mitigating of those effects.

The Department of Energy (DOE) 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 observations of environmental impacts as these projects are completed. BOEM has an ongoing study, *Real-time Opportunity for Development Environmental Observation (RODEO)*, which 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. In addition, coastal erosion from El Niño events along the Pacific has raised interest in potential OCS sand, particularly at Ocean Beach near San Francisco, California. 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 proposes and conducts 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 geological and geophysical (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 (SMWGs) 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 SMWGs and participation in regional planning groups (*e.g.*, Northeast Regional Ocean Council [NROC], Mid-Atlantic Regional Council on the Ocean [MARCO], GOM Alliance [GOMA], and California's Coastal Sediment Management Workgroup) ensures that the MMP maintains connectivity with decision makers throughout the Atlantic and Gulf regions and aligns study investments with priority needs.

#### **2.4.1 Fates and Effects**

The proposed study *Ecological Function and Recovery of Biological Communities within Sand Shoal Habitats within the GOM* has national implications and proposes to examine how biota and ecosystems respond to long-term habitat changes caused by dredging within repeatedly used borrow areas. Ship Shoal, offshore of Louisiana, has and will continue to serve as a valuable

sand resource to support the needs of multiple projects. In order to better assess the cumulative effects of these actions, the MMP seeks to examine how biota and ecosystems respond to long-term habitat changes caused by repeat dredging events. This study will complement a similar on-going study performed on Canaveral Shoals, a repeatedly dredged shoal complex on the Atlantic coast. This study will allow the MMP to observe prolonged biological, physical, and chemical recovery of borrow areas located within Ship Shoal to understand the importance of dredged habitats to benthos, fish, and trophic structure or bioenergetics. Existing project-specific, post-construction monitoring is not of sufficient duration or temporal resolution to fully understand these sand shoal complexes. In the absence of extended monitoring data, short-term perturbations cannot be differentiated from natural disturbances and seasonal changes, or longer-term trends such as climatic oscillations. Observations over an extended time frame will allow for the MMP to more fully identify the potential impacts of multiple sediment removal activities at Ship Shoal, and determine the true extent, nature, and process of disturbance and recovery. Initial data from the Canaveral Shoals project has led to some valuable information on recovery, which is necessary for improved regional management of offshore habitat availability for prey and fish species. This knowledge will improve effects analyses in NEPA documents and greatly focus and improve the outcomes of EFH consultations.

## 2.5 Future Plans

### 2.5.1 ESP Programmatic Plans

#### *International*

Ecosystems do not align neatly with international borders. Many of the challenges facing ecosystems are global in nature (*e.g.*, climate change, ocean acidification), and BOEM seeks to understand how these changes and potential impacts from BOEM-regulated activities might intersect. Other nations in the GOM are building their offshore energy industries. BOEM intends to partner with these (and other) nations to share information, create collaborative research opportunities, and improve upon management practices and scientific programming through a shared vision and approach. Currently, workshops with Mexico are planned for later this year, and BOEM looks forward to building closer relationships with Mexico and other countries regarding environmental science.

#### *Partnerships*

ESP thrives on its partnerships within the federal government as well as with external partners. These relationships allow BOEM to leverage funding and resources, share information, stay informed of new technology, policies, and scientific information, and improve communications and understanding. ESP is looking to the future and finding ways to improve its partnerships. One area of improved collaboration is occurring within DOI through the Strategic Ocean Science task team. This team will be comprised of DOI representatives in the ocean sciences and will develop agency-wide scientific priorities and practices with the goal of improving the efficiency and quality of DOI ocean science programs.

Since 1979, BOEM has partnered with the Smithsonian National Museum of Natural History for the long-term curation of its collection of marine invertebrate specimens taken during the environmental baseline surveys of various oil and gas lease sites on the U.S. East, West, and Gulf Coasts. ESP will also be looking to expand its cataloguing efforts to include archiving of

genetic samples. As part of the Global Genome Initiative, BOEM will be helping contribute to the understanding of Earth's genomic biodiversity by contributing genetic samples to the state-of-the-art archival facilities at the Smithsonian.

### ***Business Processes***

In support of ESP's mission and in support of the regional studies programs, DES is constantly seeking to improve its business practices. DES's goal is to have a robust process to ensure scientific quality while reducing administrative burden. To achieve this goal, DES has several objectives to pursue in the coming years. These include identifying areas where processes can be streamlined, developing an approach where less administrative oversight is required for procurement packages, and to increase the business acumen of BOEM environmental science staff through webinars on roles/responsibilities (*i.e.*, DES policies and law) when conducting a study for Federal government.

## **2.5.2 Marine Minerals Future Plans**

### ***Fates and Effects***

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

MMP strives to work 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. These regional data collection efforts will position the MMP to more holistically evaluate and manage EFH impacts. 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 on specific managed fish species and their habitat features. These data will support future programmatic consultation efforts and promote efficiencies in the leasing process.

### ***Social Sciences and Economics***

The most cost effective sand resources available for dredging are those located closer to shore, in shallow and more accessible locations, and with low impact footprints. These resources have been or will be exhausted in the near future and the MMP anticipates the need for sand resources in the OCS to exceed what is currently available under these cost effective criteria. Dredging technologies are currently a limiting factor in cost effective solutions for dredging in deeper water and further from shore in 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 as new innovative and cost effective methodologies for deeper dredging and long distance conveyance of sediment.

### ***Archaeological Resource Protection***

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. The MMP will continue to pursue the 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 past investments towards better understanding the 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.

### ***Information Management & Integrated Studies***

MMP is working on an OCS sand inventory and a repository of applicable marine mineral data. This effort involves 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. Data are being developed into a relational geodatabase management infrastructure and a data management plan is in development. Investments will be needed to continue building and maintaining the MMP GIS database to inform decision making based on resource availability, location, volume, and other characteristics important to coastal restoration managers.

Access to offshore sand and potential conflicts that limit access, including dredging feasibility and cost, environmental and cultural resources, and other space use conflicts (*e.g.*, energy industry, commercial fishing, aquaculture, pipelines, *etc.*) are becoming more complex and deserving of rigorous study, monitoring, and planning to manage conflicts and risk. As the lead federal agency and liaison in support of the Nation's current and long-term interests in OCS non-energy marine minerals, it is critical that the MMP continue to expand the geodatabase to develop a comprehensive understanding of OCS sand resource potential and remain engaged in regional planning bodies and associated marine spatial planning exercises to ensure that identified sand resources are avoided (where practicable) when planning for other uses.

The MMP will continue to expand the geodatabase in the future and leverage other authoritative datasets for other considerations such as EFH, hard-bottom areas, wind energy transmission lines, oil and gas pipelines, and sensitive cultural resources for additional analysis and integration. Additionally, as data sets are discovered and/or developed from marine mineral studies, these data products could be provided to fill where there are missing digital data / data products in previous studies.

The development of a comprehensive inventory of delineated sand resources within the Gulf, Atlantic, and Pacific OCS is the first step to help identify conflicts, contemplate impact tradeoffs, and inform decision making on a regional and national scale.

## 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 3). 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: large and remote planning areas; diverse and extreme environmental conditions; still-evolving hydrocarbon extraction technology; and potential environmental hazards associated with offshore activities, such as seasonal sea ice coverage.

Since the ESP began more than 40 years ago BOEM has funded nearly \$475 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.boem.gov/ESPIS/>. 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 and trophic levels, data are patchy at a large marine ecosystem scale, while environmental conditions and other anthropogenic stressors keep changing over time.

Climate change is accelerating in the Arctic and the extent of summer ice cover is decreasing more rapidly than was predicted by most global change models, decreasing to record historical lows. The loss of ice cover is causing changes to the physical oceanography, water chemistry, and ecosystem productivity, and has substantial implications for marine mammals, as well as bird and fish species that live on, below, or near the ice. Climate change also entrains many socioeconomic 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.

In 2011, BOEM released the Proposed Final OCS Oil & Gas Leasing Program 2012–2017 (BOEM 2011), which scheduled three potential lease sales in the Alaska OCS. These potential lease sales were deliberately scheduled late in the program to allow for further development of scientific information regarding the sensitive habitats, unique conditions, and important other uses of Federal waters, including subsistence hunting and fishing, as well as energy resource extraction of the oil and gas resource potential in these areas. A lease sale is scheduled in the Cook Inlet Planning Area (Figure 4) in 2016. On October 16, 2015, the DOI cancelled the remaining two lease sales, which were scheduled to occur separately in the Chukchi Sea Planning Area (Figure 5) and the Beaufort Sea Planning Area (Figure 6).

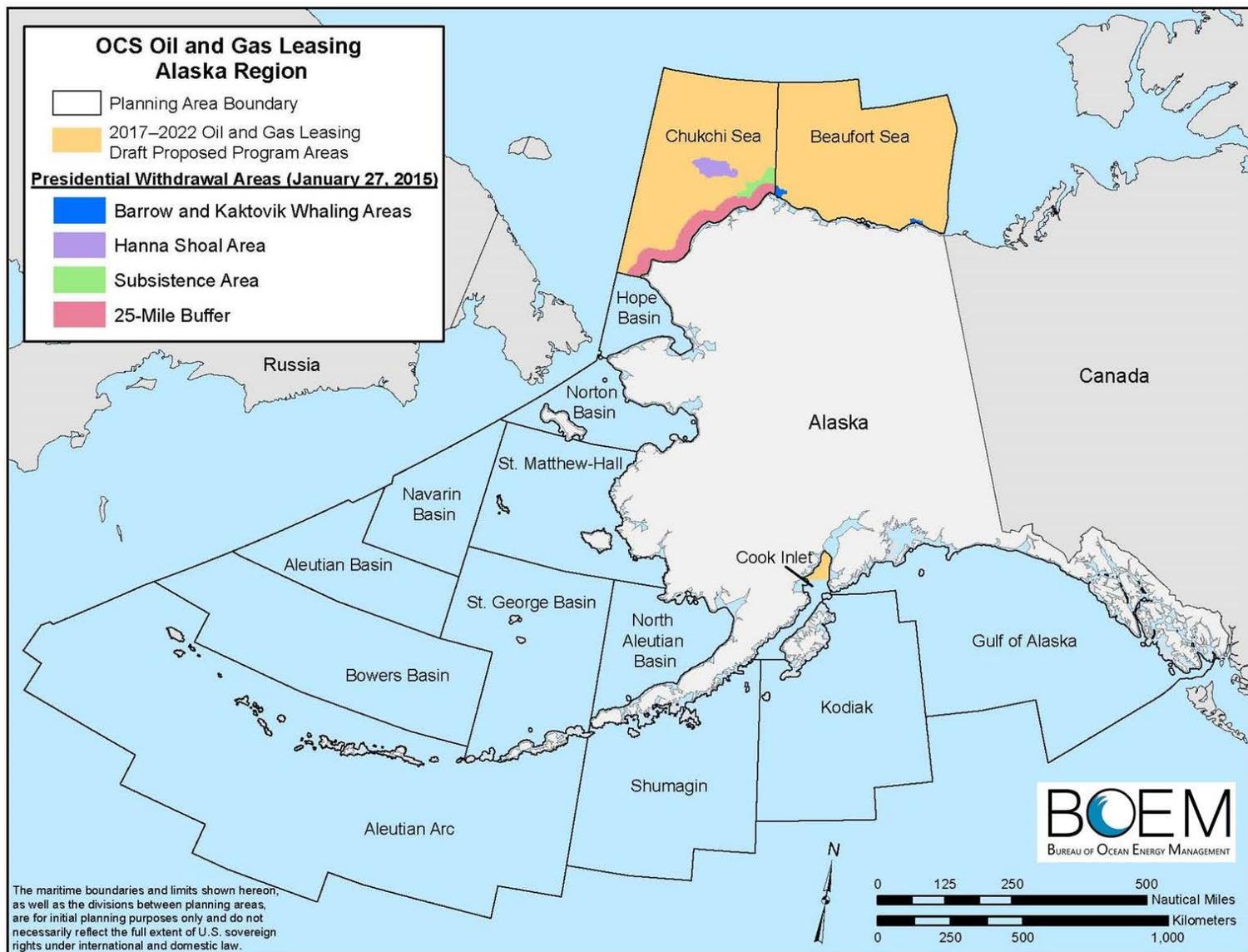


Figure 3. Alaska OCS Region Planning Areas.



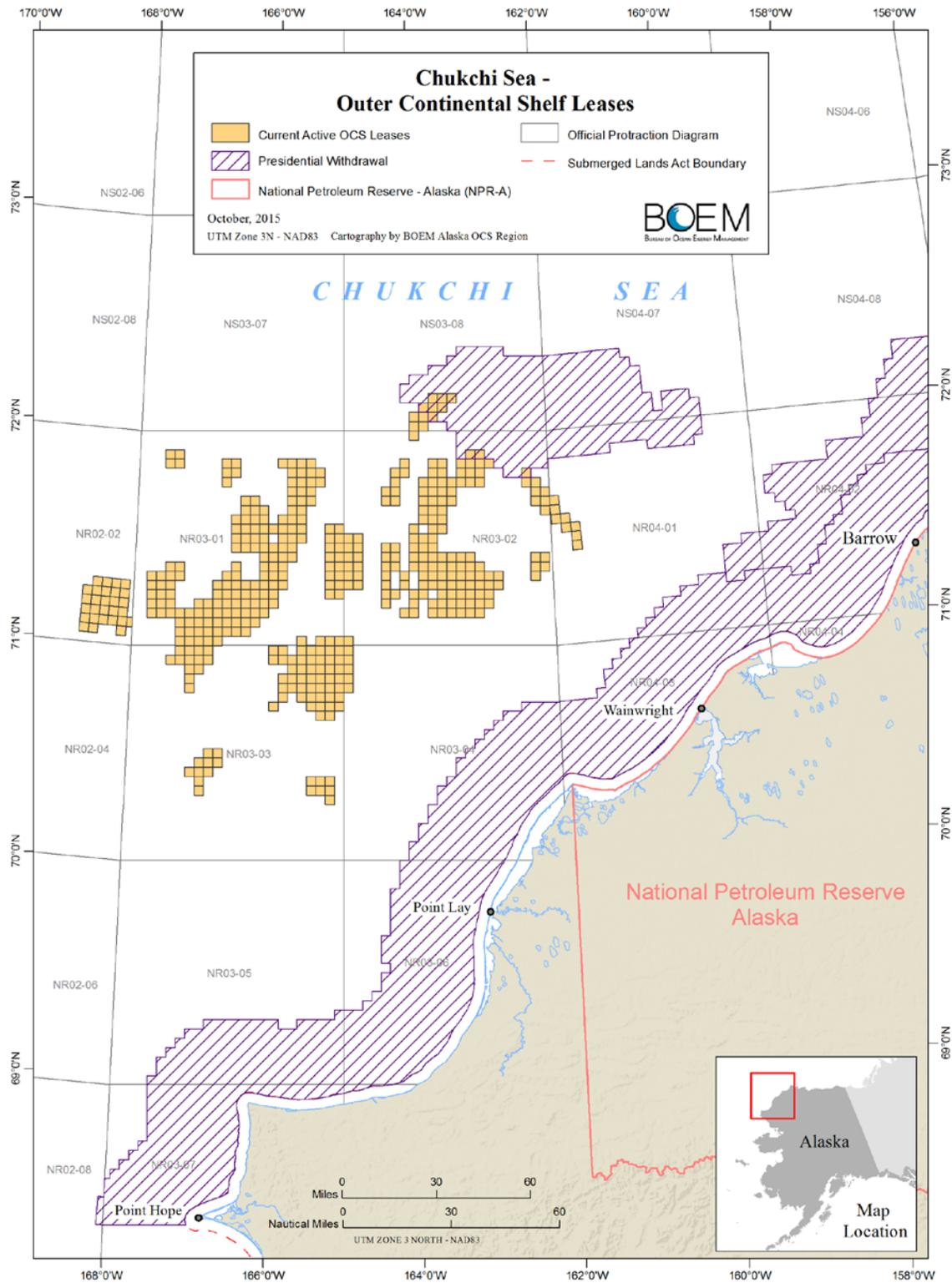


Figure 5. Chukchi Sea Planning Area.

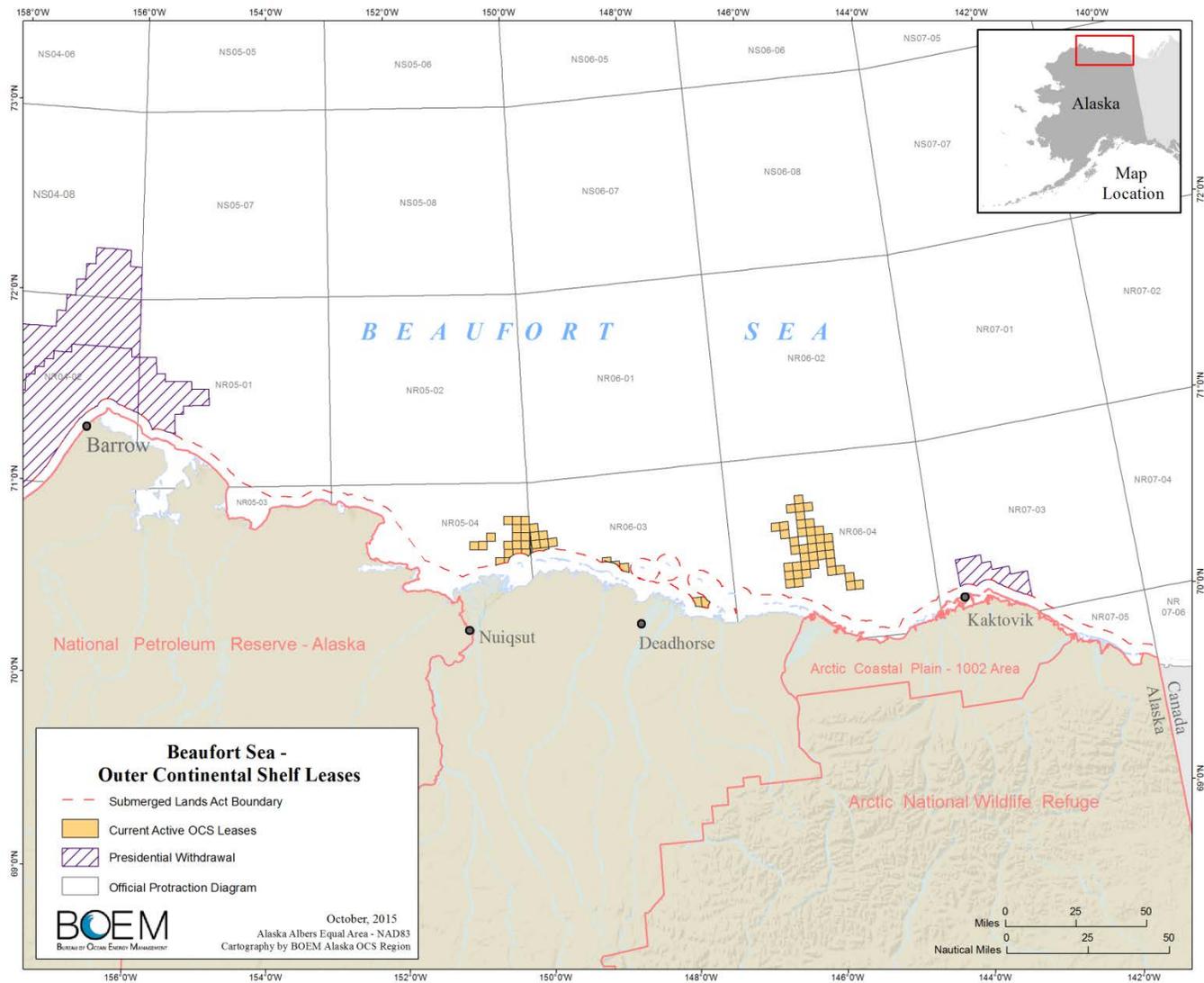


Figure 6. Beaufort Sea Planning Area.

On January 27, 2015, President Obama signed a memorandum withdrawing several areas from consideration for future leasing. Withdrawn areas in the Chukchi Sea include a pre-existing 25-mile nearshore buffer, the area surrounding Hanna Shoal, and an area to the north of Barrow that has been documented as a biological hotspot and important for subsistence harvest. In addition, two subsistence harvest areas near Barrow and Kaktovik are withdrawn from consideration in the Beaufort Sea.

In 2012, Shell completed the top hole sections of one well at the Sivulliq Prospect in the Beaufort Sea and one well at Burger A in the Chukchi Sea. Shell encountered problems while towing its drill rig to Seattle, Washington in December 2012. Shell did not conduct exploration activities in 2013 or 2014. In 2015, BOEM approved Shell's Revised Chukchi Sea Exploration Plan (EP Revision 2). This decision was informed by environmental research conducted by BOEM, USGS, U.S. Fish and Wildlife Service (USFWS), National Science Foundation, and many others. Shell drilled a well at Burger J in the Chukchi Sea. Despite finding indications of oil and gas in the Burger J well, Shell determined these are not sufficient to warrant further exploration in the Burger prospect. The well has been sealed and abandoned in accordance with U.S. regulations. Shell has stated it will cease further exploration activity in offshore Alaska for the foreseeable future, but has not yet relinquished all lease-holdings.

The Liberty prospect is located in the central Beaufort Sea about 6 miles east of the existing Endicott Satellite Drilling Island. In November 2014, primary ownership and operatorship of Liberty was acquired by Hilcorp Alaska LLC. Hilcorp submitted a Development and Production Plan (DPP) proposing construction of a gravel island and production facility for the Liberty Unit, which is estimated to contain up to 150 million barrels of recoverable crude oil. BOEM deemed this DPP submitted in September 2015, and is beginning preparation of an Environmental Impact Statement (EIS).

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 Bureau of Safety and Environmental Enforcement (BSEE) regulatory authority, whereas the State wells fall under the oversight of the Alaska Department of Natural Resources, Division of Oil and Gas. Production started in 2001 and peaked in 2004. Total production of crude oil through December 2015 is over 165 million barrels, with the Federal portion comprising nearly 29.5 million barrels.

### **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 for trends 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.

In response to Shell's decision to cease operations in the Chukchi Sea and Hilcorp's submission of their DPP for Liberty, BOEM will direct additional focus toward the Beaufort Sea. Residents of Beaufort Sea coastal communities have expressed concerns about long-term effects of OCS activities, particularly changes to currents and sedimentation rates and potential effects on social systems in the vicinity of Northstar and Liberty. BOEM will continue its long-term monitoring efforts in the central Beaufort Sea, in particular through the *Aerial Survey of Arctic Marine Mammals* and the *Arctic Nearshore Impact Monitoring in Development Area* (ANIMIDA)

sampling projects. To the extent possible, BOEM will also continue environmental monitoring activities in the Chukchi Sea. Questions that remain key issues of concern in the Chukchi Sea include: the effects on marine mammals of anthropogenic activities, including increased noise and vessel traffic, as well as the need to obtain a better understanding of the ocean and atmospheric dynamics associated with the seasonal freeze-up of sea ice.

The need for updated information about the physical and biological environment in Cook Inlet and Shelikof Strait is also ongoing. 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.

### 3.2.1 Biological

Fish and benthic organisms 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 (MSFCMA) is the Federal law that governs U.S. marine fisheries management for all OCS waters. Under the MSFCMA, 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 the National Marine Fisheries Service (NMFS) regarding any action that may adversely affect EFH. BOEM engages in consultation with NMFS officials for EFH assessment related to adult and late juvenile life-stages of a number of species, including Arctic cod, saffron cod, and Pacific salmon.

Several studies are currently ongoing to 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, USFWS, National Parks Service, the University of Alaska Fairbanks (UAF), and others to integrate biological, chemical, and physical information and to 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)*, for which an extension is planned for FY 2018, and the *Arctic Ecosystem Integrated Survey* in the Chukchi Sea; *U.S.-Canada Transboundary Fish and Lower Trophic Communities*; and *Ecological Processes in Lower Cook Inlet and Kachemak Bay*.

The study *Arctic Slope Winter Fish: Arctic Cod Spawning Survey*, proposed for FY 2017, will provide much needed information about this key species during the under-studied winter season. The study *Foodweb Simulation Models to Connect Humans and Marine Mammals with Lower Trophic* will analyze how oil and gas activities may impact ecosystem services and key arctic species. Also, *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.

### 3.2.2 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 and the bowhead whale is central to Alaska Native cultural and spiritual life. Information about bowhead feeding and habitat use is 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. Iñupiat whale hunters as well as the scientific community have raised concerns about potential cumulative impacts on bowhead whales. Additionally, noise from industrial activity is a central concern. 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.

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 facilitate 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: the *Aerial Survey of Arctic Marine Mammals*; and *Ice Seal Movements and Foraging: Village-based Satellite Tracking of Ringed and Bearded Seals*, which is planned for extension in FY 2018.

The study *Generation of Synthetic Audiograms by Applying Finite Element Modeling to CT scans for Marine Mammals* will use cutting-edge techniques to investigate the potential effects of anthropogenic noise in the ocean. Other studies planned for FY 2017 include *Identifying Sea Otter Abundance, Distribution, and Foraging Patterns in Cook Inlet Alaska, using Unmanned Aircraft Systems (UAS) and Manned Aircraft*. Also, the study *Marine Bird Distribution and Abundance in Offshore Waters* will continue to support placing seabird observers on ships of opportunity in the Beaufort Sea, Chukchi Sea and Cook Inlet planning areas. Studies examining the year-round distribution of marine mammals in Cook Inlet and aerial photo-identification of bowhead whales are also planned for FY 2018.

### 3.2.3 Physical Oceanography

Accurate information on surface wind fields, ocean currents, and sea ice is also important for assessing 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 understand the physical processes associated with sea ice. Information about wave conditions in the Beaufort Sea is also needed to assess effects on offshore oil and gas structures and potential changes in sedimentation patterns and coastal erosion.

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 HF-radar systems, offshore bottom mounted acoustic Doppler current profilers, 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 *Wave Model Output and Observations for the Nearshore Beaufort Sea* will develop a coupled wave-hydrodynamic-sediment transport model to evaluate potential nearshore impacts or changes in sedimentation transport or erosion related to changes in current and wave energy. Also proposed for FY 2017 is the study *Nearshore Hydrographic Variability in the Central Beaufort Sea*, which seeks to quantify the freshwater input to the coastal Beaufort Sea and characterize the associated temporal and spatial changes in the nearshore hydrography. Studies planned for FY 2018 include an examination of the dynamics associated with the freeze-up of sea ice.

#### **3.2.4 Fates and Effects**

Concerns about possible adverse environmental effects associated with Arctic OCS energy development remain constant. North Slope residents are especially concerned about potential contamination of their food supply, including effects from potential oil spills. 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 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. The Alaska OCS Region is also continuing the study *Updates to the Fault Tree for Oil-Spill Occurrence Estimators*, which uses statistical methods to develop oil-spill occurrence estimates for the Arctic based on historical oil-spill data from the GOM and Pacific OCS Regions. The study, *Assessment of Multiple Ocean Circulation Models to Support Ensemble OSRA Experiments*, planned for FY 2018, seeks to evaluate the strengths and weaknesses of an array of ocean circulation models with the goal of improving BOEM's oil-spill trajectory analysis efforts.

#### **3.2.5 Meteorology and 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 NEPA, 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 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 study *Community Web Access to WRF Atmospheric Model Results and Meteorological Station Data, 1979–2009*, planned to begin in 2016, will process meteorological observational data from the Chukchi and Beaufort Seas and upload them to an online data portal for external use.

### 3.2.6 Social Sciences and Economics

BOEM is also addressing concerns regarding the effects 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 imported 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 local and regional impacts from hydrocarbon exploration and development activities. Furthermore, in an ongoing effort to incorporate local and traditional knowledge in the analysis of potential environmental effects, BOEM is supporting the Local Environmental Observer (LEO) network, which was established by the Alaska Native Tribal Health Consortium, Center for Climate and Health, through the project entitled *Community Based Monitoring: LEO Network*.

In recognition of the important role that polycentric institutions, such as borough and city governments, tribal governments, Native corporations, and co-management associations play in the Beaufort Sea coastal communities, the study *Polycentric Governance in Barrow, Nuiqsut*,

*and Wainwright*, proposed for FY 2017, seeks to develop a better understanding of the structure and function of these institutional arrangements and to evaluate how they may be altered by oil and gas activities in the transitions from lease sale, to exploration, to development.

### **3.2.7 Information Management & Integrated Studies**

Timely and efficient access to data and information products is essential for BOEM to make effective, well informed policy decisions and to foster improved research and synthesis activities. BOEM has recently entered into a collaboration with the North Pacific Research Board (NPRB) on the *Arctic Marine Integrated Ecosystem Research Program*. This new \$8 million Arctic Program—led by NPRB, with partnership from BOEM, NSB/Shell Baseline Studies, and the North Pacific Marine Research Institute—will focus on processes influencing the structure and function of the Arctic marine ecosystem.

Recent investments in data collection and model generation in the Arctic and Lower Cook Inlet regions have produced extremely valuable information which is multidisciplinary in nature. While many BOEM-funded studies have produced extensive and detailed datasets, much of that information still must be assembled and converted into geospatial formats that can identify relevant characteristics such as distance from shore, and general depth range to facilitate integration into environmental analyses. The study *Geospatial Mapping – A Geodatabase and Visualization Tool Set*, proposed for FY 2017, will develop a data management framework, specifically adapted to the needs of BOEM’s NEPA analysts in the Alaska OCS Region. The study *Integration of Aerial Survey and Passive Acoustic Seasonal Distribution Data for Arctic Marine Mammals and Anthropogenic Noise Sources*, planned for FY 2018, will develop novel data products and synthesis analyses from previously funded oceanographic and protected species studies in the Western Beaufort and Northeastern Chukchi Sea.

## **3.3 Renewable Energy Science Strategy**

Section 388 of the EPO Act amended the OCSLA to give discretionary authority to BOEM to issue leases, easements, or ROW 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.

### **3.3.1 Biological**

In 2013, the State of Alaska and the City of Yakutat initiated a project to examine the feasibility of harnessing wave energy offshore of Yakutat. Though preliminary results indicate that Yakutat wave resources provide “excellent” energy source potential in both deep and shallow water, more research on environmental factors is necessary to assess the economic viability of undertaking the development. In particular, comprehensive assessments are still needed to characterize seabed dynamics, including areas prone to sediment movement and their implications for benthic habitat. Information needs are also still pressing to characterize ambient underwater noise, as well as presence and habitat implications for local fish and marine mammals. The study *Wave Energy Converter Impact Assessment*, proposed for FY 2017, will work with UAF Alaska Center for Energy and Power, NOAA, and USFWS to integrate and extend offshore environmental feasibility studies sufficient to fully assess the economic viability of wave energy projects in Yakutat and other areas of coastal Alaska. This project represents a

uniquely cost-effective opportunity for BOEM to help establish methods and procedures that can be employed in future wave energy site resource assessments in both State and Federal waters across the nation.

### **3.4 Marine Minerals Science Strategy**

The OCSLA gives discretionary authority to BOEM to issue leases for mineral resources. No lease sales for mineral resources are currently planned for the Alaska OCS Region.

### **3.5 Future Plans**

#### **3.5.1 Conventional Energy Future Plans**

##### ***Biological***

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 MSFCMA, effects on EFH must be evaluated. As commercial fish species move northward from the Bering Sea, more information is needed to evaluate EFH in the Chukchi Sea. Beaufort Sea waters are also considered EFH for salmon, and future research on salmonid reproduction in Beaufort Sea drainages is needed 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.

### ***Protected Species***

Oil and gas-related activities, including production at the Northstar site and other potential sites, may lead to effects from 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 Endangered Species Act (ESA), MMPA, and the Migratory Bird Treaty Act (MBTA) 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. 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 oil spill risk analysis (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, Environmental Assessments, and oil-spill response planning documents. In particular, more information is needed to assess the impact of ice on the nature and amplitude of upwelling and downwelling, and to gain a better understanding of the dynamics associated with river outflow plumes, especially under ice.

### ***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 Beaufort Sea Monitoring Program 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* study, the *Hanna Shoal Ecosystem Study*, and the current *Arctic Marine Biodiversity Observation Network (AMBON)*. The need for additional monitoring will continue to be re-evaluated as oil and gas development in the Alaska OCS Region 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.

### ***Meteorology and Air Quality***

Accurate specification of meteorological conditions is essential for driving and validating ocean circulation and air quality models. The need for updated meteorological data, especially in the Arctic, is ongoing. Because measurements over water can vary drastically from those over land, observational data from offshore sites in this area are especially important.

While implementing its authority for the regulation of oil and gas-related air emissions on the OCS in the Beaufort and Chukchi Seas, BOEM will need air quality monitoring information to assess the cumulative air quality impact of OCS Arctic oil and gas activity and to support compliance with the OCSLA and environmental justice initiatives. In particular, more information is needed to evaluate how high levels of substances such as black carbon and methane might impact climate change, as well as human health, in the region.

### ***Social Sciences and Economics***

Residents of the coastal communities in both the NSB and the Northwest Arctic Borough 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 addressed by further 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.

### ***Archaeological Resource Protection***

Baseline information regarding submerged cultural and archaeological resources on the OCS in Beaufort and Chukchi Seas is limited. Information on prehistoric archaeology potential is needed to support analyses under NEPA and the NHPA in relation to oil and gas activities on the OCS. The need for assessments of archaeological resource potential will continue to be re-evaluated as oil and gas development in the Alaska OCS Region evolves.

### ***Information Management & Integrated Studies***

BOEM has a long history of supporting multidisciplinary research in Alaska, beginning with the OCS Environmental Assessment Program surveys conducted between the 1970s and early 1990s. The Alaska OCS Region will continue to build upon existing working relationships with NPRB, NOAA, USGS, the Alaska Ocean Observing System, industry, and others by establishing financial cooperation, coordinated Requests for Proposals, data sharing agreements, and logistical support agreements.

#### **3.5.2 Renewable Energy Future Plans**

No lease sales for renewable energy are currently planned for the Alaska OCS Region. However, the need for studies relevant to renewable energy will be re-evaluated as interest in the development of these resources evolves in Alaska OCS Region.

## CHAPTER 4 GULF OF MEXICO STUDIES

### 4.1 Introduction

Ongoing activities in the GOM consist of conventional oil and gas development as well as non-energy marine mineral leasing of sediment resources to support coastal restoration projects. While there is no current development of OCS renewable energy resources in the GOM Region (GOMR), future interest in wind energy from offshore sources may be on the horizon. 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 7). For more information on the GOMR please visit <http://www.boem.gov/Gulf-of-Mexico-Region/>.

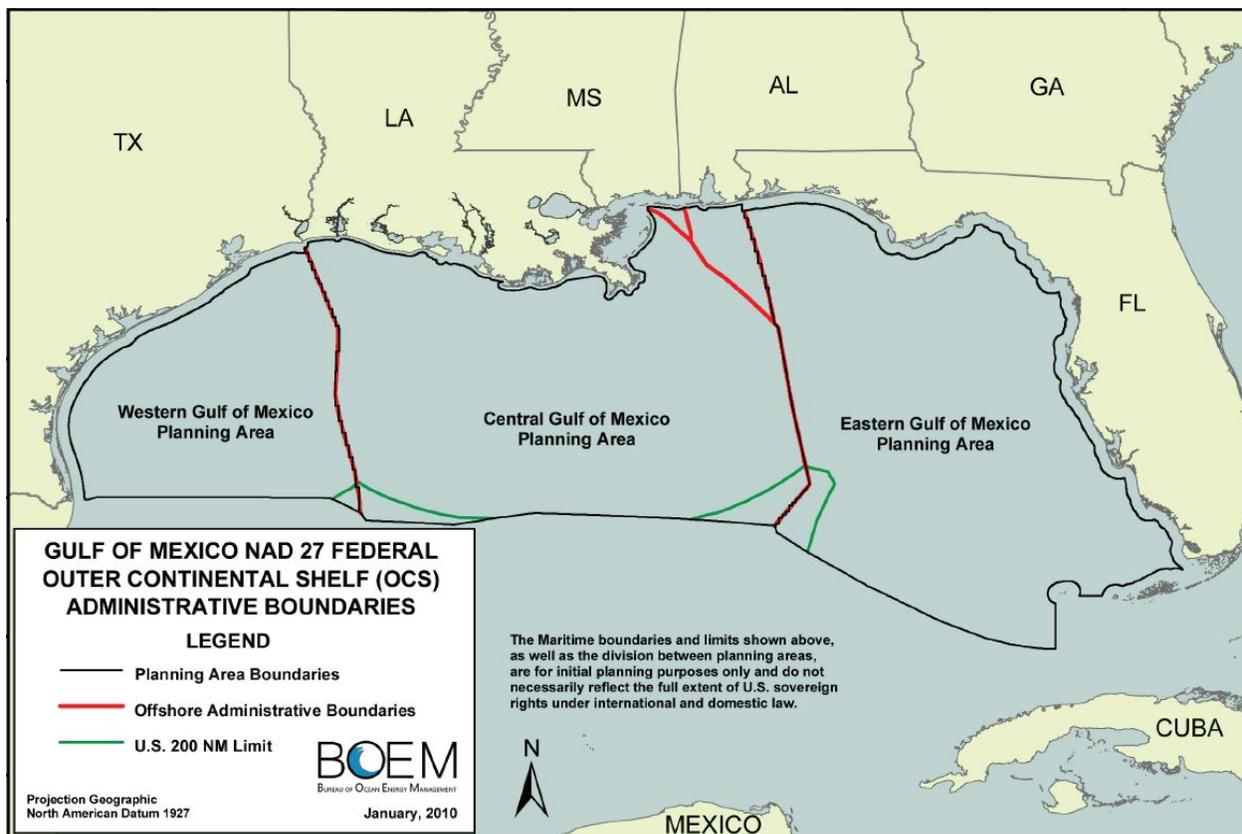


Figure 7. GOM OCS Planning Areas.

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. In 1992, the former Minerals Management Service (MMS), now BOEM, entered into a partnership with the Louisiana State University (LSU) to establish the first 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 *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 being studied. 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 are 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.

The MMP is actively leasing OCS sediment for GOM restoration projects proposed to repair natural resources damaged during the *DWH* oil spill. Projects currently under construction in the GOM include Caminada Headland Beach and Dune Restoration Project (Figure 8) 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 that these landforms provide from storms.

Increase in demand for OCS resources within the GOM was also caused by the conversion of more than 200 square miles of Louisiana coastal land to open water habitat as a consequence of Hurricane Katrina and other named storms that followed. Sand resources needed to repair the damaged coastlines and barrier islands within Alabama, Mississippi, Louisiana, and Texas are estimated to be from 250 to more than 300 million cubic yards. Major restoration efforts, including the RESTORE Act and NRDA, are requiring the use of OCS sand resources to restore coastal wetlands and barrier islands along the Gulf Coast. Additionally, future Gulf projects are planned out to 50 years as the GOM Energy Security Act contribution to restoration budgets increases starting in 2017. These multiple funding streams will ensure that the MMP will continue to provide OCS sand as a vital component to these restoration programs.



Figure 8. Aerial photograph of Caminada Headland construction, September 6, 2013. Photo credit: Patrick M. Quigley ([www.gulfcoastairphoto.com](http://www.gulfcoastairphoto.com)).

The Gulf provides a unique environment of complex competing use challenges resulting from sand resource areas that may also be optimum sites for oil and gas platforms and associated pipelines (Figure 9). These circumstances, access, and potential environmental resource conflicts are becoming more complex and deserving of rigorous and integrated environmental study, monitoring, and management.

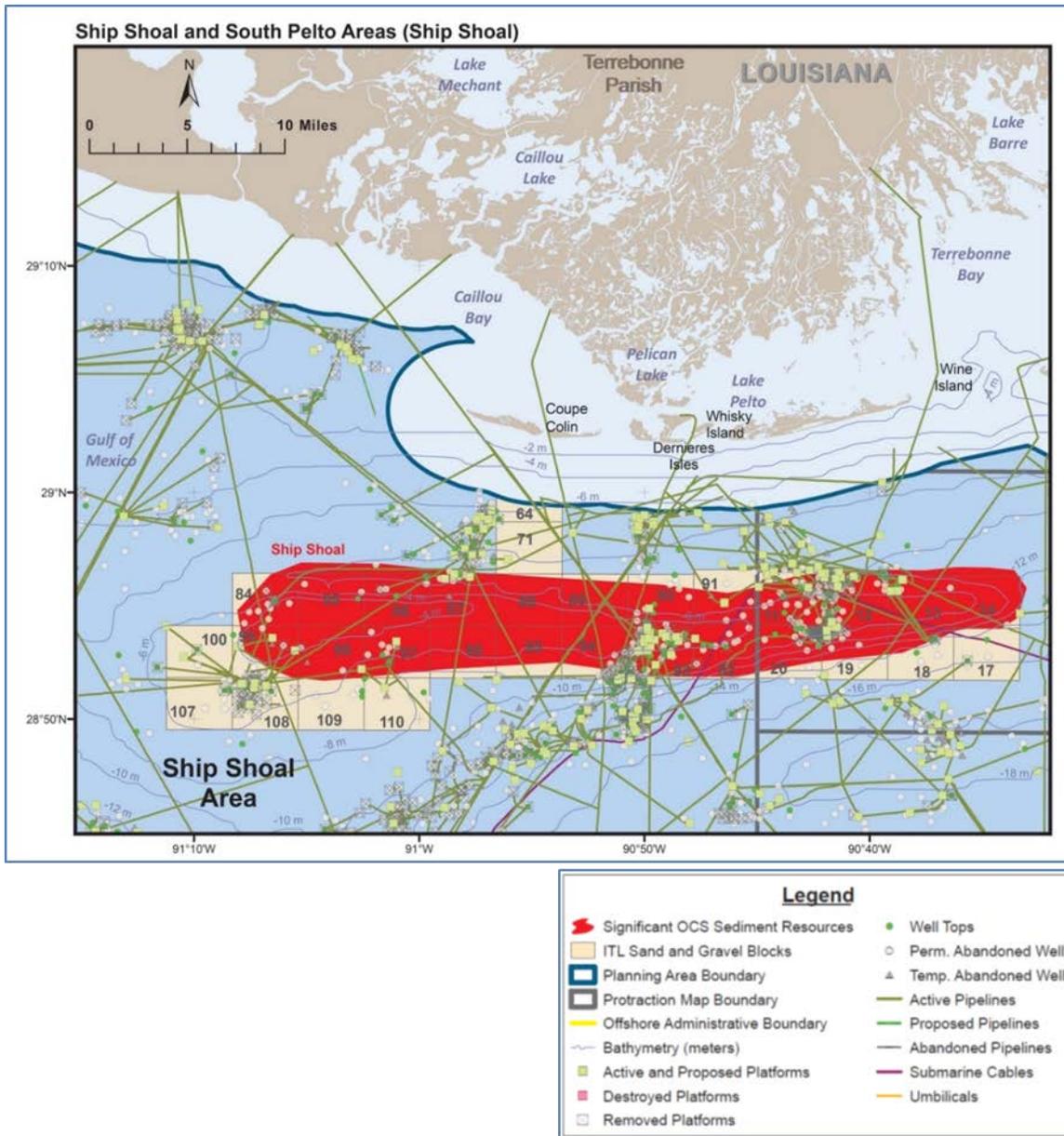


Figure 9. Complex competing use challenges with respect to oil and gas platforms and pipelines in the GOM.

## 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 more than 70 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 modeling and monitoring air quality, analyzing the cumulative impacts of human activity on coastal and marine resources, observing and documenting deepwater species, and understanding the relationship between oil contamination and wetland loss. 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 EISs, Environmental Assessments, mitigations, and other requirements from the NEPA and other environmental laws. Information acquired by these proposed studies will also assist with BOEM consultations with other Federal agencies regarding biological resources as well as Gulf Coast states and Tribes regarding cultural resources.

#### 4.2.1 Biological

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. New and ongoing energy activities touch upon every ocean province from our coastal marshes to the abyss. Several new studies have been proposed to address changing baselines and cumulative impacts across a range of Gulf habitat types and environmental resources. Regarding near-shore environments, BOEM scientists seek to improve understanding of how wetlands are impacted by oil spills in order to assess the cumulative impacts of OCS activities. A new proposed study in FY 2017, *Effects of Oil Contamination on Wetland Loss*, will assess the effects of oil contamination on wetland loss through the use of multiple technologies, including historical datasets of polarimetric Synthetic Aperture Radar (polSAR) and photographic images for the Louisiana coast. BOEM will use this information to support the OCSLA and NEPA process when preparing EISs. Another study planned for FY 2017, *Cumulative Impacts of Human Activity on Coastal and Marine Resources of the GOM*, will develop a new approach to assessing the overall cumulative impacts of human activity on coastal and marine resources of the GOM. This analysis will assess cumulative impacts to biological, physical, and cultural resources, establish benchmark conditions that quantify cumulative impacts, and estimate resource vulnerability for the purpose of focusing NEPA cumulative impact analyses in the GOM.

New studies being planned will utilize direct measurements at offshore facilities to both make use of existing infrastructure and to study interactions with platforms. Deepwater drilling and production operations usually employ industrial Remotely Operated Vehicle (ROV) systems. These ROV's have been employed for roughly the last decade to make deepwater biological observations through the Scientific Environmental ROV Partnership using Existing Industrial Technology (SERPENT) program. A study planned for FY 2017, *Gulf SERPENT for Deepwater Biological Observing: Synthesis of Historical Datasets and Continued Sampling*, will continue existing research in expanding a database of marine life from the mesopelagic and bathypelagic regions of the GOM. The study will also develop long-term time series related to deepwater ecology based on a synthesis of ROV and ancillary datasets. Another study planned for FY 2017, *Baseline Monitoring of Avian and Bat Activity and Offshore Platform Interactions*, will help fill major gaps in knowledge regarding baseline avian and bat activity and their interactions with offshore platforms. This study will provide an update on the 2005 study *Interactions Between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico* by employing autonomously recording technology to measure avian and bat species abundance and interaction with offshore platforms (Russell 2005). Information gathered in this study will

inform BOEM's compliance with the MBTA and Executive Order 13186 and will inform the NEPA process.

BOEM requires periodic evaluation of its mitigations to address NEPA needs. A study planned for FY 2017, *Multibeam Survey of Small Topographic Features to Determine Efficacy of Current "No Activity Zones,"* will specifically address evaluation of BOEM's mitigations with respect to bottom-disturbing activities. Since the 1970–1980s there has not been an update or an evaluation of the efficacy of the "No Activity Zones" (NAZs) associated with topographic features in the GOM. The NAZs distance bottom-disturbing activities away from potentially sensitive habitats. The objective of the new study is to map 20 topographic features in the GOM using a multibeam sonar system and present those data in a manner where they can be used by BOEM and NOAA to reevaluate and modify policies used to manage environmental resources.

#### 4.2.2 Protected Species

Through new studies, BOEM will continue to actively fill information needs related to protected species, including for marine mammal and sea turtles, in the GOM, to successfully inform environmental assessments and federal consultations in compliance with ESA, MMPA, NEPA, and other laws. The Bureau seeks to expand long-term monitoring datasets that will improve its ability to identify potential changes and trends in the distribution and abundances of protected species in the GOM, as related to anthropogenic and natural stressors. To this end, two new studies are being planned for FY 2018. One study, *Cabled Observatory Feasibility Study Using the GOM Fiber Optic Network for Long-Term Monitoring in Offshore Waters*, will provide a feasibility assessment for potentially developing ecosystem observatory nodes on the GOM Fiber Optic Network, with high priority given to equipping nodes with hydrophones and other instrumentation, for monitoring long-term time series related to marine mammal and other living marine resources in offshore waters. A second study will establish a GOM Deepwater Ecosystem Observatory Network using both fixed and mobile systems equipped with sensors for long-term monitoring of marine mammal, sea turtle, fish, and plankton abundance in combination with measurement of the physico-chemical environmental parameters required to understand any observed changes. This study will be coordinated closely with related ongoing studies, including the *Passive Acoustic Monitoring (PAM)* and *GOM Marine Assessment Program for Protected Species (GoMMAPPS)* Studies in the GOM, and the related *Atlantic Deepwater Ecosystem Observatory Network (ADEON) Study*. Finally, a study is being developed for FY 2018, *Supplemental Data Collection on GOM Marine Mammals Using Citizen Science*, to provide supplemental data collection on GOM protected and rare species using Citizen Science. This study is responsive to a July 2015 Memorandum issued by the OSTP and Office of Management and Budget that encouraged Federal Agencies to foster Citizen Science opportunities.

#### 4.2.3 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-1970s, 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. 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. 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.

For FY 2017, the GOMR is offering a single new study, *Characterization of Receiving Waters in the GOM*, conceived to examine contaminants from OCS platforms to test the effectiveness of the National Pollutant Discharge Elimination System permit. For FY 2018, the GOMR is proposing to evaluate a drum disposal site in the Mississippi Canyon Leasing Area. The study, *Preliminary Evaluation of the Mississippi Canyon Drum Disposal Site*, will determine if contaminants are leaking from industrial chemical waste barrels and affecting water quality within areas currently permitted for oil and gas-related activities.

#### **4.2.4 Meteorology and 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 Code of Federal Regulations (CFR) 550 Subpart C and pre-lease in the NEPA EIS cumulative analysis to support compliance with OCSLA.

For FY 2017 the GOMR is offering a single new study, *GOM Air Quality Study: Pollutant Transport, Atmospheric Dynamics, Monitoring and Modeling*, conceived to examine dispersion of air emissions from OCS platforms; update the existing air quality regulations according to the new federal regulations; evaluate the impact of emissions sources, cumulative analysis of offshore activities, and future scenario emissions in the air quality sections of NEPA documents in agreement with the new standards; implement a dispersion modeling guideline to be followed by operators; and to determine the applicability of short-range (distance less than 50 km from emission source) preferred models in the revised federal rules under practical applications for BOEM. A new study for FY 2018, *Tracer Experiments for Atmospheric Dispersion Modeling*, proposes to conduct field tracer experiments and establish routine meteorological measurements to inform atmospheric dispersion modeling and evaluate their applicability in existing air quality models used for offshore activities.

#### **4.2.5 Social Sciences and 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 are 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 the push to address local-level effects are significant concerns in the Gulf. The second strategy focuses on developing a "dynamic baseline." All social impact assessment (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 and, lately, many of these issues have related to the *DWH* spill. In terms of number, if not budget, the majority of past Gulf socioeconomic studies were cooperative agreements conducted under the LSU CMI (see the GOMR studies webpage for more information).

The FY 2018 proposed study, *The Offshore Support Supply Vessel, Construction and Labor Market Industries in the GOM*, addresses a significant information gap in the Gulf's extensive industry. Monitoring is a Bureau-wide concern; faced with Gulf's complexities, the GOMR will conduct certain socioeconomic monitoring as repeated and repeatable studies of specific areas of concern. For FY 2017, GOMR proposes the *OCS-Related Coastal Infrastructure Fact Book Update* study to develop the dynamic baseline but will also be regularly repeated to serve to monitor significant changes in oil-related infrastructure over time. *Socioeconomic Impacts of OCS Infrastructure: Shifts in Recreational Behavior* will analyze changes in platform uses since a decades-old study (an important SIA issue), but its findings will determine if monitoring is warranted. *The Fiscal Impacts of the GOM OCS Industry* addresses a major gap in baseline information and SIA, and it supports the GOMR's ongoing efforts to provide better local-level or regionalized socioeconomic impact assessments. *Social and Economic Impacts of OCS Activity on Individual and Families: Sociocultural Monitoring* functions similarly to the infrastructure monitoring study; it updates baseline information sociocultural impacts, but it monitors a complex area of change through a repeated and repeatable study. *The Production and Distribution of Subsistence in Coastal GOM* is a follow-up to early exploratory research; damage claims resulting from the *DWH* spill identified the non-market use of subsistence resources as an important and remarkably poorly understood GOMR resource. Lastly, GOMR proposes the *Support for Socioeconomic Impact Assessments of Offshore Energy Development in the GOM Region* study to provide flexibility for rapidly obtaining socioeconomic information related to specific questions.

Other studies follow up on the same GOMR priorities. The FY 2018-proposed *OCS-Related Transportation Infrastructure in Louisiana and Texas* and FY 2017-proposed *Forecasting Helicopter Operations and Utilization in the U.S. GOM* address gaps in our understanding of the OCS industry. The first study addresses the inland portion of the intermodal transportation system (trucks, trains, barges) in terms of economic sectors and physical traffic flows. The latter addresses the helicopter sector both as a transportation system and a manufacturing sector. The *Houston and New Orleans: Urban Centers, Urbanization, and the GOM Petroleum Industry* study and *Assessment of the OCS Leasing Program's Demographic Effects on the GOM Region* study, proposed for FY 2018, are both part of the baseline focus, and along with the FY 2017 "Fiscal Impacts" part of the GOMR's effort to develop a more regionalized SIA. The Houston-New Orleans study will explicate local-level impacts for two of the most impacted areas in the GOMR; the Fiscal Impacts study will look at variability across the region. *The Visual Impacts of OCS Activity on Horn and Petit Bois Islands* study, proposed for FY 2018, addresses SIA stakeholder concerns. Finally, the GOMR has produced a rich body of research that calls for synthesis and the GOMR proposes to begin an in-house effort with limited ESP support in FY 2018 through the study *ESP: Support for the Synthesis of GOM Region Socioeconomic Research*.

#### 4.2.6 Archaeological Resource Protection

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 levels. The GOMR is seeking information about impacts to submerged cultural resources from oil spills, impacts to coastal archaeological sites from sea-level rise, collecting baseline information and site characterizations on significant deepwater shipwrecks in an area intended for future oil and gas development, and testing new and innovative methods for identifying potential preserved paleolandforms on the OCS. An ongoing information need for the GOMR in FY 2017 is to understand the impacts of the 2010 *DWH* oil spill on submerged cultural resources in the deepwater environment. Impacts to submerged cultural 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 research consortia such as the Gulf of Mexico Research Initiative, NAS, and RESTORE Act Science Program, therefore a significant information gap exists. In order to fill this information gap, BOEM proposes to continue examining impacts from the 2010 *DWH* spill on submerged archaeological resources. The *GOM Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology, and Archaeology Project II (GOM-SCHEMA II)* proposes to examine impacts and assess the extent of ecosystem recovery eight years after the spill. The first GOM-SCHEMA project conducted sampling in 2014 and found that sites near and to the northeast of the Macondo wellhead (and exposed to the documented subsea plume) were negatively impacted by exposure to oil and chemical dispersant four years after the spill. GOM-SCHEMA II proposes to re-examine these sites and their resident microbial communities in 2018, four years after the first study's sampling efforts, to measure ecosystem recovery (microscale) as well as quantify site degradation (macroscale), allowing BOEM to engage in long-term monitoring of these sensitive, submerged cultural resources.

Other new studies proposed for FY 2017 include continuation of the archaeological investigations at the Monterrey shipwrecks in Keathley Canyon through the study, *Interdisciplinary Research at the Site of Three 19<sup>th</sup> Century Shipwrecks*. The three Monterrey shipwrecks represent perhaps 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 proposed for FY 2017, *Mapping the Late Pleistocene Landscapes of the GOM Through 3-D Seismic Analysis*, intends to examine the use of three-dimensional (3-D) seismic data as a tool for mapping submerged paleolandforms that might contain preserved evidence of prehistoric human occupation of the OCS. Lastly, BOEM proposes to assist the State of Louisiana by funding a study to examine the impacts of sea-level rise and coastal erosion on archaeological sites and Traditional Cultural Properties. The study, *Archaeology and Coast in Crisis: Traditional Cultural Properties at Risk*, proposes to collaborate with the State as well as with Tribal groups and modern/descendant communities through ethnographic/anthropological data collection and archaeological investigation of a select number of terrestrial sites at risk of submergence in the near future.

The GOMR anticipates that its archaeological resource information needs for FY 2018 will include examination of the *C.P. Baker* site, which is historically significant as the first documented explosion of a drilling rig offshore. The study, *Archaeological Investigations of the C.P. Baker Shipwreck Site*, is proposed as a collaboration with NOAA. Another study proposed

for FY 2018, *Identification and Modeling of Wooden Shipwreck Remains of Pensacola Bay, Florida*, proposes to assist the State of Florida with evaluating and refining current survey methodologies and management strategies for shallow water wooden-hulled shipwrecks that are often very difficult to detect. Lastly, the *Surveying and Testing Submerged Paleolandform Features in the Western GOM: The Sabine Pass Project* proposes to conduct targeted geophysical survey and coring at two potential submerged prehistoric features in Sabine Pass Area Block 6 first identified during a 1986 MMS study. The features included a buried, formerly subaerially exposed shell deposit and, nearby, a discrete location containing floral remains often associated with prehistoric human occupation and burned and carbonized bone from a variety of estuarine and marine fauna.

Information from these studies will inform BOEM's NEPA analyses including cumulative impacts; NHPA Section 106 consultations; consideration of potential effects of BOEM-permitted activities on historic properties per NHPA; long-term monitoring of environmental damage to submerged cultural resources; management strategies for cultural resources (terrestrial and submerged); and evaluation, testing, and potential revisions to BOEM's currently prescribed survey methodologies for detecting buried paleolandforms that may contain preserved prehistoric archaeological features and for detecting wooden hulled shipwrecks in shallow water.

### **4.3 Renewable Energy Science Strategy**

Although the GOMR has traditionally focused on conventional energy exploration and development and marine minerals extraction, interest in renewable energy development and alternative uses of existing OCS structures is emerging as a new priority. Currently, the majority of renewable energy facilities (*e.g.*, wind turbines) in the GOMR have been constructed along the Texas Gulf coast where wind is abundant. As renewable energy development expands onshore within State boundaries, interest in offshore wind sources may also increase. In addition, the abundance of offshore oil and gas-related facilities in the Gulf lends support to the consideration of this infrastructure and associated onshore design/fabrication facilities for alternative uses in the future.

#### **4.3.1 Information Management & Integrated Studies**

In order to evaluate the wind energy potential within the GOM OCS, the GOMR proposes to conduct a feasibility analysis for wind energy development in FY 2017. The study, *Renewable Energy Potential Assessment for the GOM OCS – Wind Energy Feasibility Study*, will proactively assess Gulf-wide OCS wind potential and velocities using a geospatial distribution analysis; address technology constraints in relation to seafloor bathymetry and siting of facilities, available and evolving technologies, and use of existing infrastructure; and analyze the economic factors related to wind energy development on the OCS. Finally, perspectives will also be provided on the environmental implications of wind turbines such as those related to decreased carbon emissions and consideration for avian flyways.

### **4.4 Marine Minerals Science Strategy**

The GOM OCS and shorelines are unique as these ecosystems are experiencing not only sea level rise, but subsidence and anthropomorphic forcing, such as from hydrocarbon extraction, pipeline and platform emplacement, sediment starvation, and large scale dredging projects designed to protect coastal resources and habitat. All of these activities compete for real estate and resources, including sediment, which is increasingly being extracted from the OCS. This

requires cooperation among stakeholders to prioritize activities and projects. BOEM is working with these stakeholders to maintain data on competing uses within the OCS, collecting existing G&G data on available sediment resources, and working to protect valuable sediment resources from unnecessary encroachment by pipelines, *etc.* Additionally, existing laws are being enforced by BSEE that require the removal of decommissioned pipelines and related infrastructure to unburden sediment resources and habitat. BOEM MMP will continue these efforts and also utilize the opportunity to study these unique habitats that continue to thrive under these increasing pressures.

With numerous ongoing studies still underway from the previous FY, there is only one proposed new start within the Gulf MMP jurisdiction. This study, entitled *Ecological Function and Recovery of Biological Communities within Sand Shoal Habitats within the GOM*, is described under the national studies section; as the findings from this study will be applicable to all multiple use borrow areas, regardless of location.

## 4.5 Future Plans

### 4.5.1 Conventional Energy Future Plans

The GOMR anticipates the continued development of OCS oil and gas resources as well as marine minerals for coastal restoration activities well into the future. While interest in renewable energy development and alternative uses of OCS oil and gas-related infrastructure is beginning to emerge in the Gulf states, the GOMR's information needs will continue to focus primarily on understanding the long-term effects of the oil and gas and marine minerals programs on the human, coastal, and marine environments as well as compiling baseline characterizations of natural and cultural resources within areas that may someday be available for oil and gas development (*e.g.*, the Eastern Planning Area). Additional information needs will be fulfilled through continued long-term monitoring programs and studies that acquire information on cumulative impacts from the *DWH* oil spill on a variety of resources. 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. Other future opportunities for acquiring Gulf-wide environmental information may come from partnerships and collaborations with Mexico and perhaps even Cuba; two nations that are in the early stages of developing the offshore oil and gas resources within their territorial waters.

### ***Biological***

BOEM will continue to design and perform studies to understand potentially changing baselines for living marine resources and habitats from near-shore to the deepest waters of the GOM. The stakeholder community recognizes the especial importance of these studies as the number of direct and indirect stressors to resources and habitats grows, including from oil and gas activities, deepwater fishing, marine pollution, and climate change. Needs for re-assessing baselines across pelagic and benthic biological resources are especially important post-*DWH* oil spill. 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. Deepwater studies will

continue to broaden our limited knowledge base of deepwater ecology, including studies of plankton, fish, coral distributions, and Potentially Sensitive Biological Features.

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. In particular, BOEM is working together with the larger GOM community, including GOM Coastal Ocean Observing System, to expand and enhance ocean observing assets in the Gulf. This observing system is likely to take several years to fully build out and will provide sustained and long-term understanding of living marine resource health and productivity in offshore waters, including related to ongoing restoration activities. BOEM also will be expanding joint international studies, including with Mexico and other countries, to better understand biological resources and habitat from a larger “One Gulf” perspective. This perspective is of especial importance for understanding migratory corridors and potential cumulative impacts across the long distances traversed by many marine animals.

### ***Protected Species***

The agency will continue to work closely with the stakeholder community to implement new programs for studying and monitoring of protected species populations in the Gulf environment. BOEM will expand its partnerships to leverage research needs across multiple institutions, agencies, and programs that have common goals. For example, RESTORE Act programs and NRDA will both provide restoration and monitoring funds for various protected species injured during the *DWH* oil spill, including marine mammals, sea turtles, seabirds, and their marine habitats. BOEM will work to coordinate with and leverage research through these programs. BOEM will continue assessment of data collected through the Protected Species Observer (PSO) program during seismic surveys, to help ensure the effectiveness of mitigations in place to protect cetaceans and sea turtles during seismic surveys. Given marine sound as an important topic, the Bureau will continue to expand implementation of a PAM network in the Gulf and other measures determined by BOEM’s current development of a Gulf G&G Monitoring Program. The Bureau will look towards sustained implementation of the newly developing GoMMAPPS program to quantify and understand long-term trends in species abundance and distributions as related to various anthropogenic and natural stressors.

### ***Physical Oceanography***

The GOM OCS Region does not anticipate proposing new Physical Oceanography studies in the immediate future. Study needs will be reassessed over the course of the FY.

### ***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. Concerns have been expressed that the oil and gas industry may contaminate these resources or alter the supporting ecosystem. Understanding the chronic, sub-lethal 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. 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.

### ***Meteorology and Air Quality***

The GOM OCS Region does not anticipate proposing new Meteorology or Air Quality studies in the immediate future. Study needs will be reassessed over the course of the FY.

### ***Social Sciences and Economics***

The Social Sciences and Economics Science Strategy section described the challenges facing Gulf Region 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.

### **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 has prepared a revised version, which will include 23 Economic Impact Areas built largely on the distribution and activities of oil-related industries and conducted a study that analyzed aspects of the regional economies of the newly proposed impact areas and their relationships to the OCS industry. One objective of such experiments 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. The GOMR is considering other approaches as well.

### **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 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 (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 and have underscored the importance of Citizen Science. 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."

### ***Archaeological Resource Protection***

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. The GOM-SCHEMA study, initiated in FY 2013, is examining microbial community structure and function on deepwater shipwrecks as a result of exposure to oil and dispersant from the 2010 *DWH* spill, and a follow-up study is proposed for FY 2017. Microbial response to environmental perturbations appears to affect the natural processes of wood degradation and metal corrosion, which, as a result, has implications for site preservation as well as continued availability of hard structure for recruitment of deepwater micro- and macro-fauna. Long-term monitoring of historic 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, long-term monitoring efforts of spill impacts on deepwater shipwrecks will be a continued need beyond FY 2018. Future needs for archaeological resources will continue to seek an understanding of the diversity of cultural resources, site formation processes, and the potential eligibility of submerged cultural resources for listing on the National Register of Historic Places.

### ***Information Management & Integrated Studies***

The GOM OCS Region anticipates proposing new Information Management and other studies for conference sponsorships and outreach/education activities in the FYs beyond 2018. Study needs will be reassessed over the course of each FY.

#### **4.5.2 Marine Minerals Future Plans**

As a result of the *DWH* 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<sup>2</sup> 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 properties. Through various venues such as the 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 GOM 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)

---

<sup>2</sup> The oil and gas company BP plc was formerly named British Petroleum.

- *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 OCS by the Florida Geological Survey, Louisiana Office of Coastal Protection and Restoration, and Virginia Division of Geology and Mineral Resources*

In addition, BOEM MMP is currently working with stakeholders to design a Gulf Sand Assessment Project, which will mimic the intent of the Atlantic Sand Assessment Project, as it will seek to further define the quality and quantity of available sediment resources in the Gulf OCS. This will entail field efforts to include geophysical and geological investigations. The results of this effort will assist decision makers in efficient borrow area use planning, and also delineate critical sand resources to be avoided by future competing uses such as pipeline siting. This supports BOEM MMP's efforts to bolster its inventory of OCS sand resources nationwide, as a critical step in their effective management.

### ***Fates and Effects***

BOEM continues to study how dredge areas evolve and potentially impact infrastructure and/or resources of concern located adjacent to the pit. These types of analyses are critical as the volumes of sediment extracted for shoreline restoration and habitat reclamation expands as the size of these projects balloons in response to the pressures from sea level rise, increased storm activity, and land loss. 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. 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 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.

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.

### ***Information Management & Integrated Studies***

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. Additionally, MMP holds a Science Exchange Meeting that is focused on providing updates on MMP applied studies, facilitating discussion on research efforts, and identifying opportunities for continued cooperation and leveraging of resources. Active stakeholder engagement through the SMWG, the Science Exchange Meeting, 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.

## CHAPTER 5 PACIFIC STUDIES

### 5.1 Introduction

The ESP started in the Pacific OCS Region (Pacific Region) 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 pre-lease to post-lease), (4) change to a frontier area for renewable energy production, and (5) recent interest in marine sand resources from the State of California. BOEM Pacific Region's responsibility now encompasses ongoing oil and gas operations, renewable energy development from both wave and wind energy, and potential mineral leasing. The Pacific Region stretches from the U.S.-Mexico border to the U.S.-Canada border and includes the OCS around the State of Hawai'i.

The ESP in the Pacific Region is evolving and is expanding its 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, California, and Hawai'i. No studies specific to Pacific OCS marine mineral resources are ongoing or proposed in this SDP; however, there will be future information needs (including the need for environmental studies) as opportunities to explore and extract those resources become increasingly attractive to states and coastal counties, especially in California.

For the FYs 2017–2019 SDP, BOEM Pacific Region participated in outreach to many thousand stakeholders for input. This included both public and private academic institutions, federal and state agencies, the general public, private consultants, Tribal governments, and representatives of Native Hawaiian interests. BOEM Pacific Region received and considered 25 study ideas from stakeholders, including universities, consultants, NOAA, and USGS. Additionally, seven BOEM Pacific staff proposed nine study ideas. Regional managers and staff met and considered all relevant and mission-oriented studies for both FY 2017 and FY 2018. Those studies found to be of immediate importance were prioritized and are included in this SDP.

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 (Figure 10). It also explains the urgent need for studies to inform immediate renewable energy leasing decisions and to subsequently regulate renewable energy projects that are proposed in the Pacific Region (Figures 11, 12, 13). Each proposed study, regardless of the topic of study, is tied to a regional environmental assessment, federal or state consultation, or a decision point that BOEM must undertake.

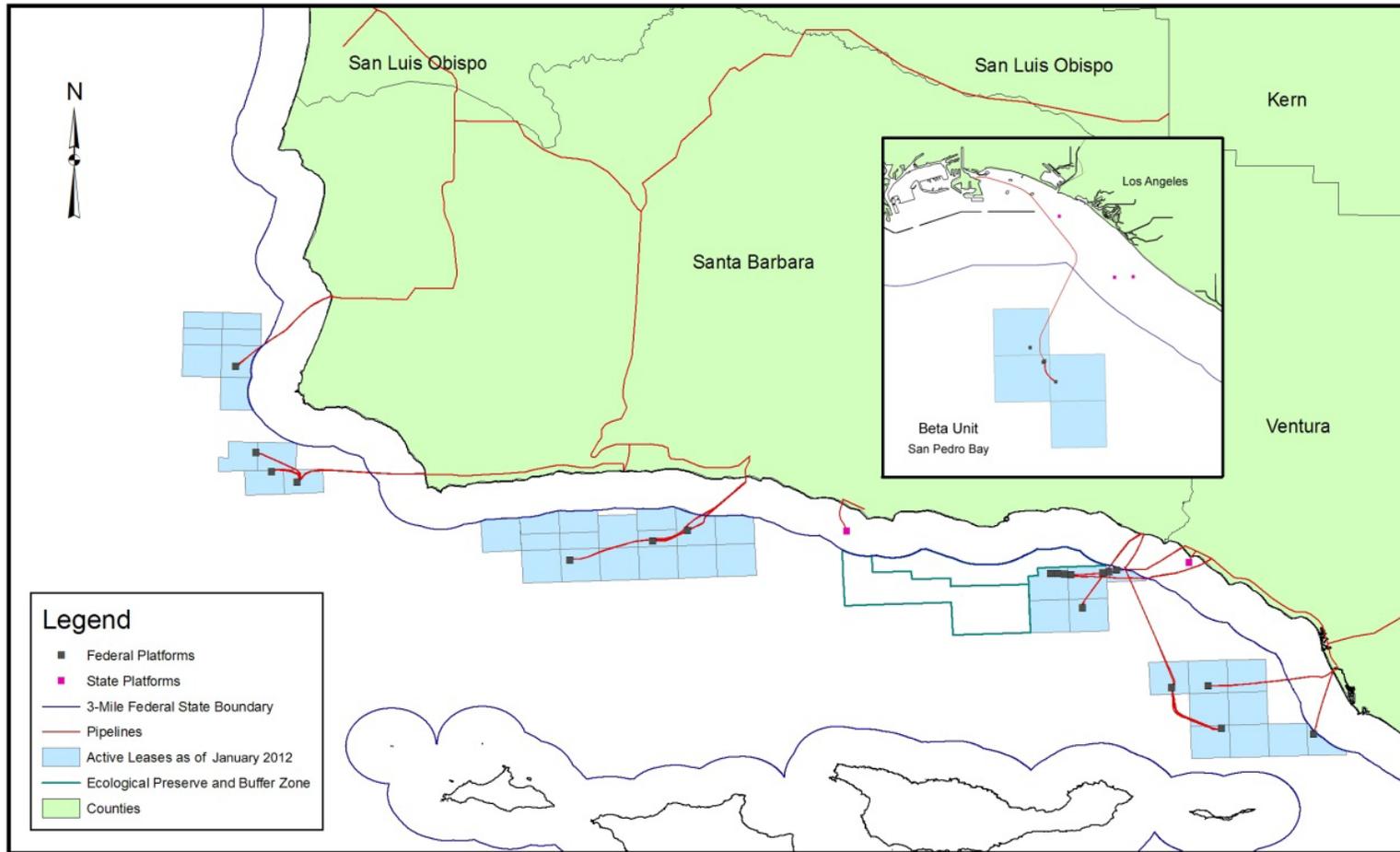


Figure 10. Oil and Gas Leases and Facilities in the Pacific Region.

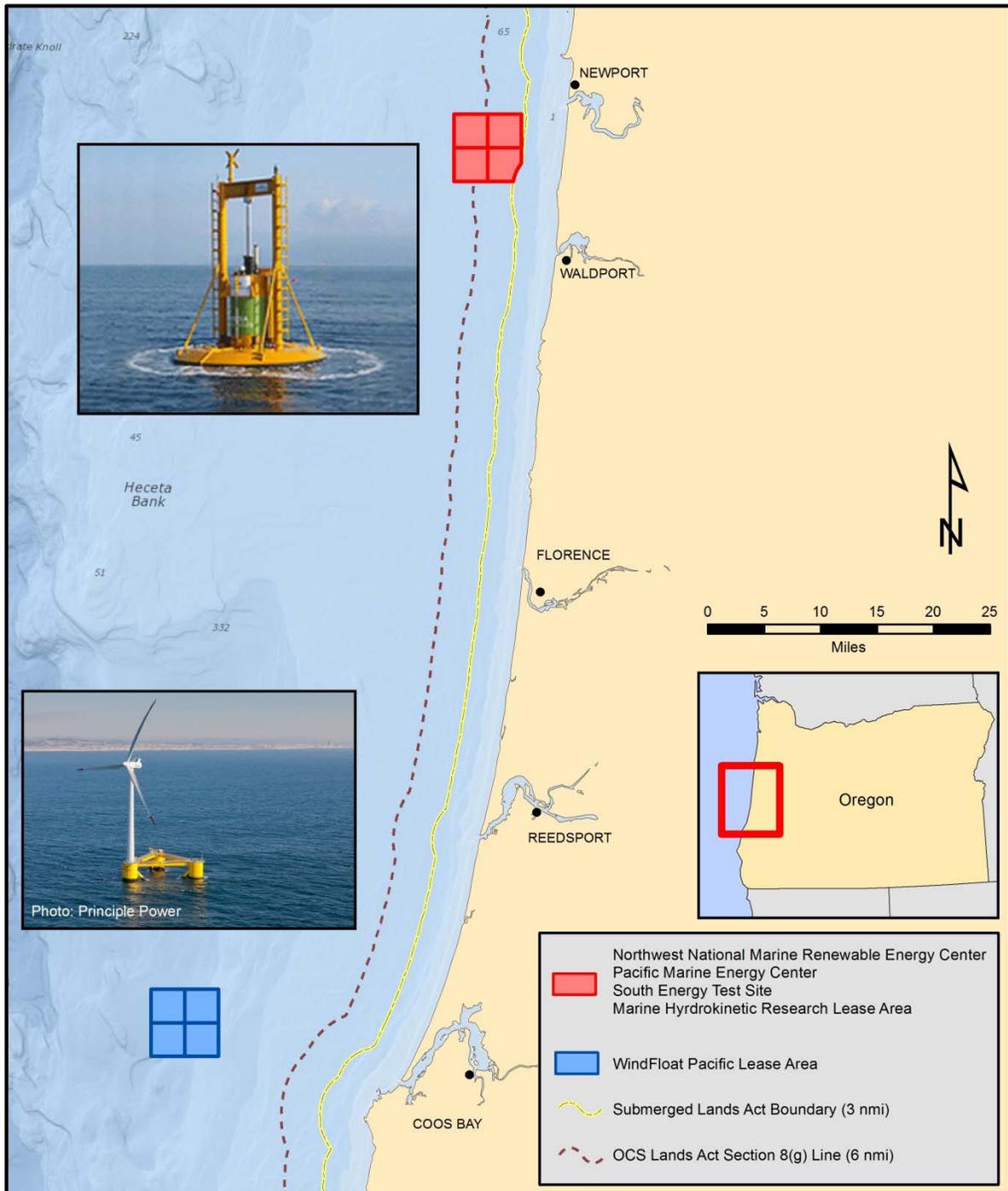
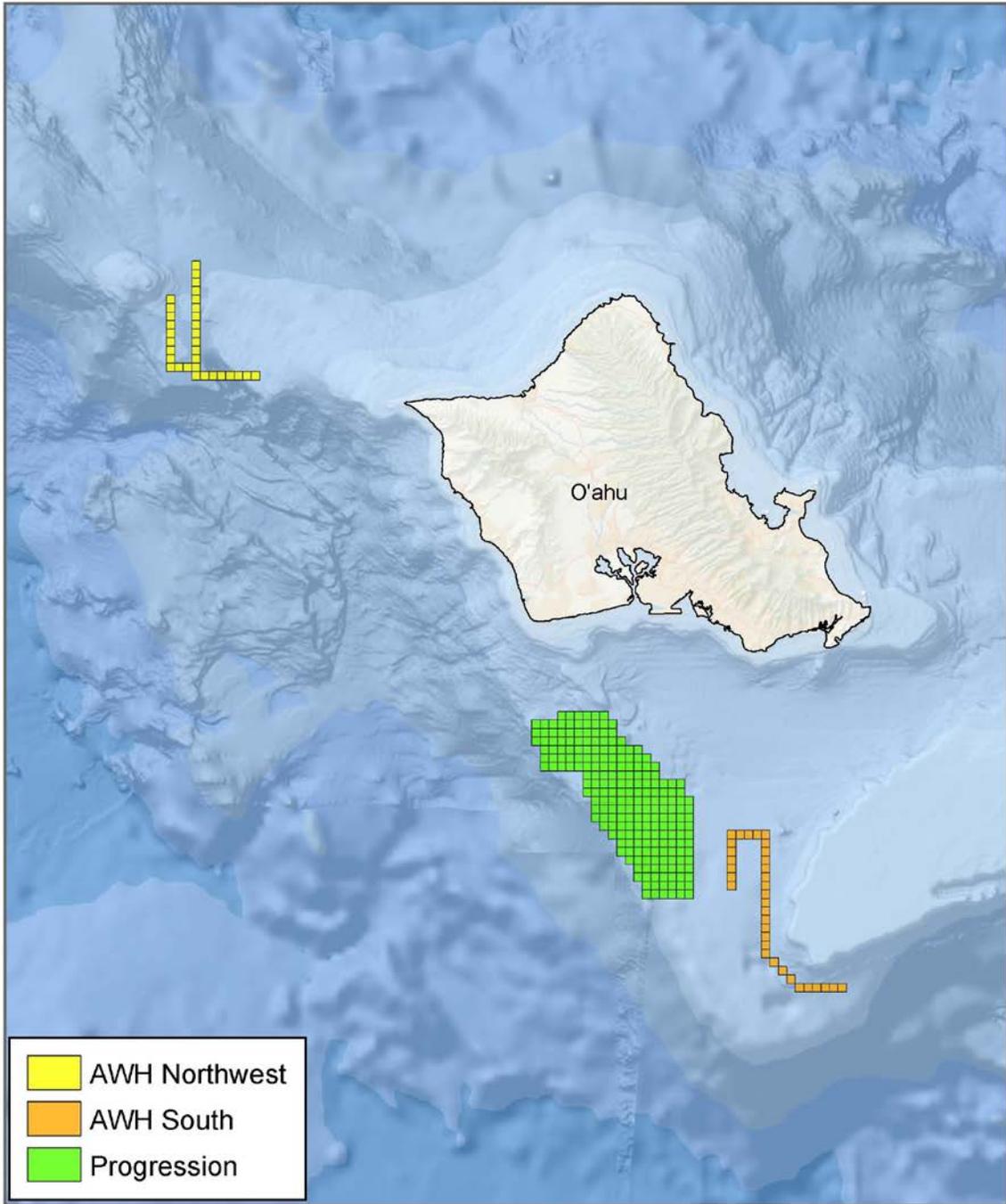
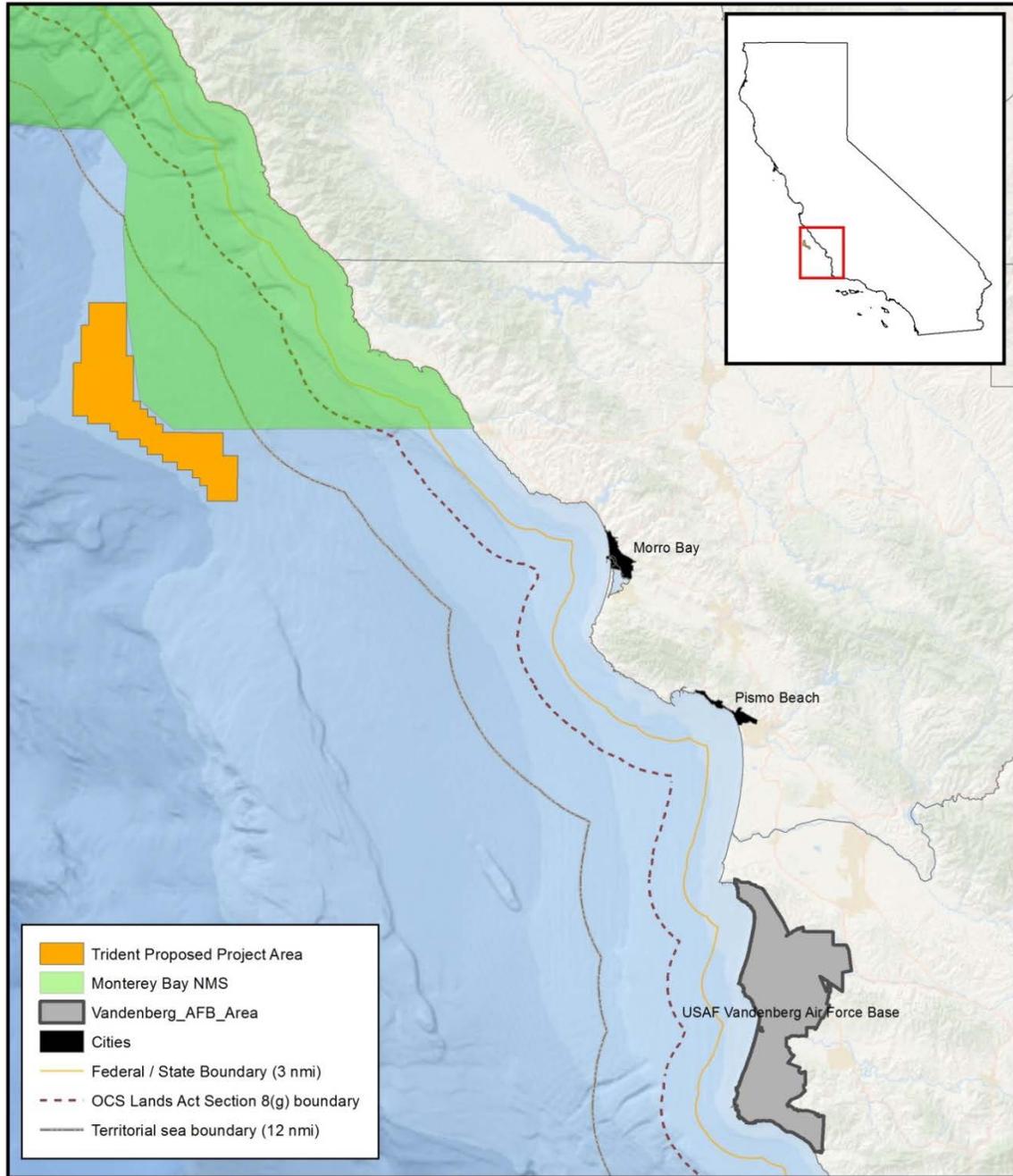


Figure 11. OCS Renewable Energy Projects in the Oregon OCS.



Coordinate System: WGS 84: UTM Zone 4N  
Service Layer Credits: Esri, DeLorme, GEBCO, NOAA NGDC, and other  
Document Path: H:\GIS\Maps\Hawaii\Hawaii (All Projects) (3-8-16).mxd

Figure 12. OCS Renewable Energy Projects in the Hawai'i OCS.



Trident Proposed Project Area = 82,552.97 Acres

Document Path: H:\GISMaps\Trident\Trident Project (1-26-16).mxd

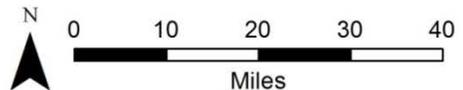


Figure 13. OCS Renewable Energy Projects in the California OCS.

## 5.2 Conventional Energy Science Strategy

Typically, the OCS oil and gas management program is addressed as pre-lease and post-lease. Pre-lease 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 10). Annual production from these leases is currently 17.6 million barrels of oil and 27 billion cubic feet 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. Studies proposed in this SDP address information gaps, inform environmental reviews of new and revised oil and gas development plans, and support BSEE'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. The recent resurgence of interest in decommissioning allows BOEM limited time to answer questions regarding platform removal. Studies must be planned well in advance for decommissioning as it involves major activities that have never occurred in the Pacific Region, and will actually be the first for BOEM, when industry removes complex platforms in ultra-deepwater.

All petroleum platforms in the Pacific Region are within 11 miles of shore, and many are closer than 5 miles (Figure 10). Existing production and development activities on oil and gas leases offshore southern California will continue into the foreseeable future. Several operators have recently replaced pipelines, drilled new wells, repaired infrastructure, and generally improved and increased possible production with long-term plans to continue. In May 2015, the failure of a major onshore pipeline resulted in a terrestrial and shallow subtidal oil spill, the inability to transport oil from several platforms, and suspensions of operations for some platforms off Santa Barbara and San Luis Obispo counties, which in turn has sparked new discussion about decommissioning. The shut-in of terrestrial pipelines 901 and 903 has curtailed approximately 62% of the oil and 83% of the gas production for the Pacific offshore region due to the inability to transport oil and/or gas. Although it continues to be difficult to predict when decommissioning will actually occur, depression of oil and gas prices, aging infrastructure, and an increase in inquiries about the process from industry have brought the possibility of decommissioning again to the forefront. 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. In FY 2015 and again in FY 2016, industry contacted BOEM and BSEE to discuss regulations and processes regarding decommissioning and/or potential reefing of obsolete platforms in the Region; however, to date, no company has officially initiated the two-year process.

BOEM must acquire information from studies to inform decisions on existing and new Pacific Region production activities, potential decommissioning, and on the risks inherent to those activities (*e.g.*, oil spills). The proposed studies for conventional energy will support potential near-term NEPA documents and BOEM/BSEE decisions, including evaluation of conductor pile driving for new wells from platforms off Los Angeles County, preparation for decommissioning of platforms off Santa Barbara and San Luis Obispo counties, fulfil Section 2 of Executive Order 13112 (Invasive Species), continue research into pre- and post-oil spill community structure, and the return to production of all platforms affected by the onshore pipeline failure in Santa Barbara

Channel and Santa Maria Basin. While these studies support NEPA review, they also will be used to fulfill BOEM's consultation and analysis requirements under the ESA, MSFCMA, and MMPA.

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  
Objective:
  - Survey shoreline communities near platforms for natural variability
- Goal 2: Continue to prepare for decommissioning  
Objective:
  - Understand the biological connectivity among platforms and natural reefs

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

### 5.2.1 Fates and Effects

Potential impacts to the shoreline are of particular concern in the Pacific Region because OCS operations are located very close to shore. Public concern about potential impacts has a considerable influence on planning and operations. Ongoing monitoring of rocky intertidal sites adjacent to OCS production facilities allows BOEM to directly assess potential and/or real impacts to the coastline from OCS operations, specifically accidental oil spills. With these data, BOEM can evaluate impacts to shoreline resources from OCS activities by differentiating between naturally occurring effects and anthropogenic impacts. The proposed study *Pacific Regional Investigation Survey and Monitoring (PRISM)* will allow BOEM analysts to conduct more accurate offshore oil and gas risk analyses for planning and ongoing conventional energy operations and provide NEPA review for both conventional and renewable energy programs. Because it includes sites in Oregon and California, the study will also provide some baseline information for evaluation of future marine renewable energy projects such as wave energy off Oregon or commercial wind energy installation off south-central California.

BOEM needs to continue to advance its knowledge of the biological connectivity of natural reefs and manmade structures in southern California, as well as understand the possible contribution of each platform to mainland and island marine communities. Oceanographic modeling suggests various degrees of potential connectivity among Pacific OCS platforms, harbors, and natural habitat for invertebrate taxa with a representative range of planktonic larval durations that provides a basis for hypothesis testing using genetic analyses. The degree of exchange of both native and non-native propagules between source and destination sites is a measure of habitat connectivity. Offshore oil platforms, by providing novel attachment substrate for encrusting invertebrates, may increase habitat connectivity by serving as "stepping stones" that may increase the potential success of dispersal. This information is needed to elucidate the role that offshore artificial structures may have in supplying propagules that can influence the composition and function of biological communities. The proposed study *Understanding Biological Connectivity among Offshore Structures and Natural Reefs* will enable BOEM to prepare for decommissioning of platforms off Santa Barbara and San Luis Obispo counties and

comply with the duties of federal agencies that are outlined in Section 2 of Executive Order 13112 (Invasive Species).

### 5.3 Renewable Energy Science Strategy

Prospective developers of deepwater wind and wave energy conversion devices have applied for leases on the Pacific OCS (Figures 11, 12, 13). Leasing and permitting renewable energy in the Pacific Region and permitting seafloor power cables on the OCS that originate from terrestrial renewable energy, which is being discussed in Hawai‘i, will involve new environmental considerations and a long-term strategy for environmental studies. The renewable energy projects require studying regions well outside the oil and gas production areas 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 Hawai‘i.

The interest in renewable energy includes wave energy conversion and deepwater floating wind off California, Oregon, and Hawai‘i. In summer 2015, BOEM received the Construction and Operations Plan from Principal Power to build and operate the offshore floating wind facility called WindFloat Pacific, and BOEM is conducting the relevant environmental review and analyses for the activities. Environmental review for the marine hydrokinetic (MHK) research lease called Pacific Marine Energy Center is underway with the Federal Energy Regulatory Commission, which is the lead agency for the project. BOEM has reviewed applications for a wave energy research lease off Newport, Oregon, and for a deepwater floating wind energy commercial lease off Coos Bay, Oregon (Figure 11), and is reviewing lease proposals for floating deepwater wind off O‘ahu, Hawai‘i (Figure 12). 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. In 2016 BOEM received an application for a deepwater floating wind energy commercial lease off Morro Bay, California (Figure 13). Interest for siting commercial renewable energy now encompasses areas off three West Coast states.

BOEM 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 O‘ahu, and south-central California, and include information on the risks inherent to those activities (*e.g.*, bird and/or marine mammal collisions and fisheries exclusion). The baseline resiliency and variability of ecosystems is another area of emphasis, especially for offshore California. The nearshore area of south-central California is known through academic studies; yet the area of interest to renewable energy development offshore on the continental slope for both California and Hawai‘i remains unmapped and understudied. It is highly likely that the offshore area off south-central California and off south O‘ahu will become areas of competitive interest to industry leading to lease auctions. Understanding the biological and physical characteristics of the areas prior to the initiation of competitive activities will lead to better and more informed NEPA assessments, environmental reviews, and application of better mitigations.

The proposed studies for renewable energy will support near-term responsibilities for NEPA documents and BOEM decisions, including an environmental review for a wind energy commercial lease off south-central California, a commercial demonstration project off Coos Bay

Oregon, and two commercial wind leases off O‘ahu. While these studies support NEPA responsibilities they also will be used to fulfill BOEM’s consultation and analysis requirements under the MBTA, MSFCMA, ESA, and MMPA. Near-term decisions include those associated with leasing, shore construction, offshore installation, operations, and maintenance of floating wind turbine devices off California, Oregon, and Hawai‘i.

The goals and objectives of BOEM’s Pacific Region science strategy for renewable energy are:

- Goal 1: Continue to acquire baseline information on species and habitats  
Objectives:
  - Explore and characterize sites offshore south-central California
  - Delineate seabird colonies on the Main Hawaiian Islands
  - Expand marine mammal and protected species surveys into ecosystem data collection and analyses
- Goal 2: Continue surveys of protected species  
Objective:
  - Update central and southern California coastal seabird and marine mammal survey data
- Goal 3: Track local community perceptions as renewable energy development occurs  
Objective:
  - Describe community perspectives before wind energy installations offshore Hawai‘i

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

### 5.3.1 Protected Species

Renewable energy projects on the OCS of south-central California are offshore of existing seabird colonies and potentially in the migratory path of the Pacific flyway. The Bureau of Land Management and the MMS funded seabird and marine mammal surveys in the Southern California Bight in 1975–1978, in central and northern California in 1980–1983, and in southern and central California in 1999–2002. While these surveys provide a good foundation of information for the area, they require updating, given the potential shifts of species’ distribution and abundance that may have occurred over the past four decades. The proposed study *Seabird and Marine Mammal Surveys near Potential Renewable Energy Sites Offshore Central and Southern California* would repeat and refine the methodology used in earlier studies to provide up-to-date information and establish a more robust longitudinal data set from which to draw for environmental analyses. The results will provide up-to-date information on species composition, distribution, abundance, and seasonal variation of seabirds and marine mammals from the southern limit of the Monterey Bay National Marine Sanctuary to the U.S.-Mexico border. Results will be used in potential NEPA documents and to fulfill consultation and analysis requirements under the MBTA and MMPA for a wind energy commercial lease off south-central California.

The AW Hawaii Wind, LLC (AWH) projects are on track to be the first offshore wind projects considered for O‘ahu and among the first full-scale projects in the nation to use a floating

structure to support offshore wind generation in the OCS. Several Hawaiian seabird species, including endangered Hawaiian petrels are killed by terrestrially sited island wind turbines; future turbine infrastructure at sea and marine cable-laying operations pose strike, grounding, and mortality risks to free-ranging seabirds. This risk will vary according to species, time of year, and environmental conditions. Currently, BOEM, federal, state, and local resource managers lack comprehensive, quantitative data to map seabird colony locations, extents, and breeding population sizes throughout the main Hawaiian islands. This basic population information—compiled in previous MMS-supported seabird colony catalogues for California, Oregon, Washington, and Alaska—is now urgently needed for Hawai‘i. The proposed study *Atlas of Main Hawaiian Island Seabird Colonies* will allow BOEM to evaluate threats to colonies and adjacent high-use offshore waters, to provide a reference to measure population trends, and to best inform place-based mitigation and restoration actions for potential effects.

NOAA conducts marine mammal population Pacific surveys within the three large oceanic systems for marine mammals (Alaska and Pacific Northwest, Southwest Coast, and Hawai‘i and Eastern Pacific) on a sequential and cyclical basis. Whales travel huge distances across the entire Pacific OCS Region. BOEM needs to gain information at large ecosystem scales to better understand the baseline and changing conditions within which BOEM may allow development of offshore renewable energy. In 2013, the Marine Mammal Commission recommended that BOEM Pacific Region partner with other state and federal resource agencies, academic institutions, and private researchers to support broad-scale, multi-year, seasonal wildlife surveys. BOEM met with NMFS and the U.S. Navy in March 2016 to develop a strategic plan for rotational marine mammal assessment surveys across the Pacific that will address each agency’s information needs. The ultimate goal is to develop a partnership between our agencies and regions that will allow for better and more consistent marine mammal data collection across the Pacific. The proposed study *Pacific Marine Assessment Partnership for Protected Species (PACMAPPS)* will help fill spatial and temporal gaps in current survey efforts.

### 5.3.2 Physical Oceanography

BOEM Pacific Region received an application for a commercial lease of 100+ turbines within an area of about 200 square miles using floating wind energy conversion devices offshore south-central California. Knowledge of the distribution and sensitivity of biological habitats and archaeological sites offshore south-central California is necessary for imminent management decisions regarding leasing and development. The general ecology of the shoreline/beach and nearshore kelp bed areas of south-central California has been characterized. However, farther offshore the oceanic area of interest, 20–35 miles, 500–1000 m water depth, on the continental slope remains an unmapped and unstudied expanse. Specifically, mapping and sampling of slope and canyon communities as well as exploration for other areas of potential significance is needed for informed decisions regarding potential wind turbine siting, distribution of habitats and historic sites, and the sensitivity of associated biological communities to impacts. The proposed study *Exploration and Research for California Coastal and Ocean Renewable Energy (Cal CORE) I: Data Synthesis, Mapping, and Analyses* is the first step in the process to define mitigations and identify hard bottom areas, archaeological sites, and any associated sensitive deep shelf and slope communities that energy development should avoid. Results will be used in potential NEPA documents and to fulfill consultation and analysis requirements under the MBTA, MSFCMA, ESA, and MMPA for a wind energy commercial lease off south-central California.

### 5.3.3 Social Sciences and Economics

The AWH projects are on track to be the first offshore wind projects considered for O‘ahu and among the first full-scale projects in the nation to use a floating structure to support offshore wind generation in the OCS. The projects provide a unique opportunity to gather socioeconomic data before consideration for construction and installation. BOEM lacks information about perspectives toward recreational and/or commercial resources in light of potential renewable energy installations. The proposed study *Public Awareness and Perception of Offshore Wind Development in Hawai‘i* would acquire information about awareness and perception of offshore wind energy prior to energy development; that information is needed for BOEM’s NEPA analyses for AWH projects and could potentially be used in a subsequent effort to assess how awareness and perception change after energy development. This information could also contribute to Pacific Island marine spatial planning efforts, provide additional information for the BOEM-Hawai‘i OCS Renewable Energy Task Force, and assist coastal planners in O‘ahu.

## 5.4 Future Plans

This section presents a general discussion of Pacific Region issues that BOEM anticipates may be of interest in the future. BOEM 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, MHK wave energy conversion, and wind energy conversion), and mining for marine sand, over a broad geographic area that includes the OCS off four states (California, Oregon, Washington, and Hawai‘i). 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, state, and industry interests whenever and wherever that interest arises, whether from a task force or lease application for renewable energy offshore Oregon, California, and Hawai‘i. Although the State of Washington has not yet expressed interest in forming a task force for renewable energy, Washington and BOEM remain in close coordination for use of the OCS. 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 Region studies, and this interest will only increase as industry inevitably moves toward decommissioning OCS facilities. Consideration will be given to the review of completed oil and gas-related studies, some of which are several decades old, and to determining the need for updating that information. BOEM may soon need additional studies specific to southern California fish, fisheries, birds, toxicology, physical oceanography, and marine mammals prior to decommissioning. All future proposed studies for conventional energy will support near-term NEPA analyses and BOEM/BSEE decisions. While these studies will support NEPA review, they also will be used to fulfill BOEM’s consultation and analysis requirements.

### 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 Hawai‘i and the U.S. West Coast, where there is increasing interest in OCS wind and wave energy. BOEM’s Pacific Region 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 is, and will continue to be, important for BOEM to foster partnerships, where prudent.

Efforts to garner urgently needed information are underway through collaborations with other federal agencies, researchers, and stakeholders, including regionally and ESP-funded studies to predict 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. The Region recognizes the importance of integrating natural and social sciences in planning and decision making for offshore energy.

The collection of baseline data prior to commercial development will gradually change to site-specific assessment, the timing of 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 Hawai‘i has accelerated and expanded to include multiple OCS sites in water depths of 100–1000 m. Additionally, the Governor of California has enlarged the state’s energy portfolio to include renewable energy from the OCS, and BOEM received an application for a commercial wind energy lease for 100+ deepwater floating turbines. As a result of this expanding interest, Pacific Region studies will need to assess and monitor multiple and disparate ecosystems. All future proposed studies for renewable energy will support near-term and potential NEPA analyses for BOEM leasing decisions. While these studies will support NEPA review, they also will be used to fulfill BOEM’s consultation and analysis requirements.

#### **5.4.3 Marine Minerals Future Plans**

No studies specific to Pacific OCS marine mineral resources are ongoing or proposed in this SDP; however, there may be future information needs including the need for environmental studies. Over the past six years, winter storms and high tides have stripped many California beaches of sand and high-surf events have eroded seashores and cliffs that support coastal dwellings. Unfortunately, natural replenishment has not occurred in large part due to a long-term state-wide drought and impediments to natural stream flushing. In the past, California has relied on rainfall to carry sediment out to coastal waters, where it is deposited back on the shoreline and into shallow subtidal areas. As a consequence to significant shore erosion, the California Natural Resources Agency reinitiated discussion with BOEM in FY 2015 regarding potential sand resource leases. In early FY 2016, the Agency requested that BOEM join the California Sediment Management Workgroup as a federal advisor. BOEM representatives from the Pacific Region Office of Strategic Resources and Headquarters MMP met with the Workgroup in December 2015.

Discussions with the State of California, BOEM, and the Army Corps of Engineers are ongoing and requests for information on the marine mineral leasing program continue. As those discussions and a determination of need by the State of California mature, BOEM expects to potentially recommend studies for marine minerals.

BOEM Pacific Region will remain responsive to the interest expressed by the State of California whenever and wherever there is a need for sand resources to replenish eroded beaches. A study to determine the characteristics of an OCS sand resource off Ocean Beach (near San Francisco) was considered in 2007 and reconsidered and discussed in FY 2015 and FY 2016. If California continues to express an interest, or makes a formal request, that study will be reconsidered.

#### **5.4.4 Stakeholder Outreach and Partnerships Future Plans**

For the past several years, BOEM has reached out separately to major stakeholders for their thoughts and ideas on the direction of Pacific renewable energy studies. The formal letter process was successful for the first few years; however for this FY 2017–2019 SDP, BOEM Headquarters took the lead and sent an email to over 7,000 stakeholders (groups and individuals) soliciting research ideas. This approach will continue into the future. Ideas for needed information and consequent study design will also come from BOEM’s Pacific Region SMEs 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. The 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 2015 and early FY 2016 BOEM Pacific Region met with all NOAA National Marine Sanctuary programs in California and Hawai‘i, USFWS, USGS, DOE, NOAA NMFS Southwest and Northwest Science Centers, and NOAA National Centers for Coastal and Ocean Science. The Region looks forward to expanding this effort in the future and possibly working toward joint regional ecosystem science conferences.

In FY 2015, BOEM Pacific Region completed a Pacific Region Science Communications and Outreach Plan. The purpose of BOEM’s Pacific Region outreach and communication is to increase BOEM’s visibility and enhance its reputation as a science-based organization that develops the nation’s offshore resources in an environmentally responsible manner. Science communications and outreach can broaden awareness and increase public confidence in BOEM’s science-informed decision making. The goal of the Pacific Region Science Communications and Outreach Plan is to help BOEM communicate in a manner that is strategic, vision-based, and effective. The Region has and will continue to expand communication and outreach resources with videos, photos, open webinars, and social media, specifically regarding regional studies.

## CHAPTER 6 ATLANTIC STUDIES

### 6.1 Introduction

The Atlantic OCS extends from Maine to Florida and is divided into four planning areas (Figure 14). The OCS planning areas extend from the State/Federal boundary at 3 nautical miles (nm) out to the outer boundary of the Exclusive Economic Zone (EEZ) at approximately 200 nm. Although not by design, these planning areas roughly coincide with the Large Marine Ecosystem (LMEs) along the Atlantic as defined by NOAA (see <http://www.lme.noaa.gov/>). On the Atlantic OCS, the Renewable Energy Program and MMP are actively managing leases, while the Conventional Energy Program is not currently pursuing oil and gas leasing. In July 2014, BOEM issued a Record of Decision 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

In March 2016, BOEM announced its Five-Year Proposed Program which removed the potential for oil and gas leasing during 2017–2022 in the Atlantic. After a robust public comment process, the Mid- and South Atlantic Program Area lease sale proposed for 2021 in the Draft Proposed Program were removed from the Proposed Program for a number of reasons, including strong local opposition, conflicts with other ocean users, including the Department of Defense and NASA’s Wallops Flight Facility on Wallops Island, Virginia, and current market dynamics. The decision to remove the Atlantic from the 2017–2022 Program included careful consideration of the comments received from governors of affected states. In their responses to BOEM, both the Governors of Virginia and North Carolina acknowledged the developmental risks associated with an offshore oil and gas leasing program in the region and indicated that a revenue sharing program was necessary to offset these risks.

In keeping with the long-term view and mission of the ESP, BOEM will continue to strategically pursue specific studies which add to our knowledge of the North and South Atlantic LME and to provide baseline information to inform decision making across program areas, including for future Five-Year Programs. Environmental research and knowledge related to OCS activities can take years to develop, but is a necessary component of mapping new habitats and understanding the relative sensitivity of ecosystems to potential anthropogenic and natural stressors.

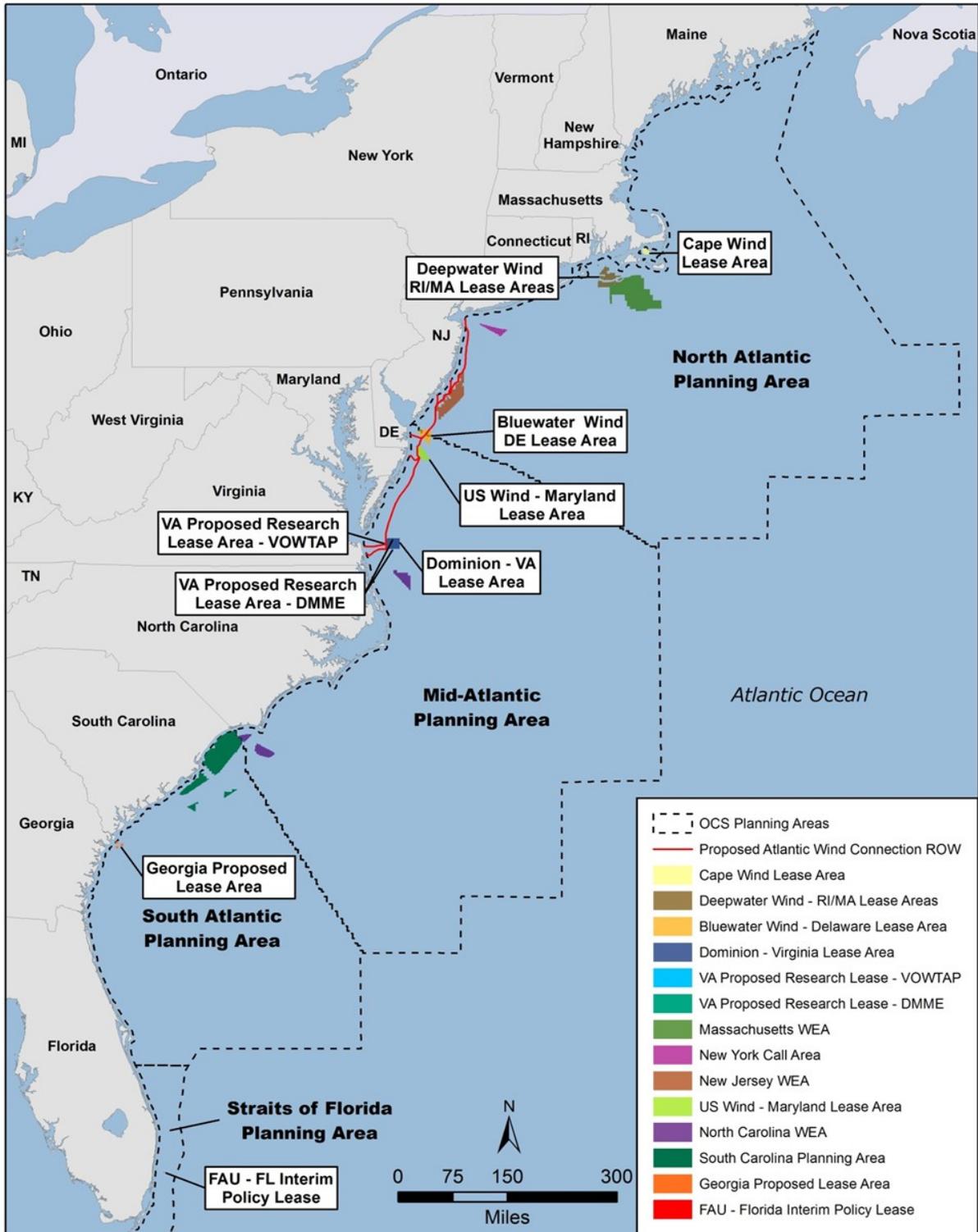


Figure 14. Atlantic OCS Planning Areas for Renewable Energy.

### 6.1.2 Renewable Energy Program

BOEM's 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 14). The focus of the program is currently for wind and MHK (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.

### 6.1.3 Marine Minerals Program

Following the extensive damages caused by Hurricane Sandy (Figure 15) response efforts along the Atlantic coast have focused on a more proactive regional approach to building coastal resilience rather than addressing sand renourishment needs at the individual project scale. Hurricane Sandy damage also triggered a wide range of emergency management response initiatives, such as restoration of multiple federally authorized USACE coastal storm risk management projects damaged or destroyed by the storm. 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.

Following Hurricane Sandy, MMP utilized approximately \$2.35 million in Disaster Relief Appropriations Act funds following Hurricane Sandy to support two collaborative studies with NASA, the University of Florida, 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.

In support of regional partnerships in the Atlantic region, the MMP participates in the NROC, MARCO, the Governor's South Atlantic Alliance, 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 and a contract to acquire geophysical and geological data from Maine to Miami, Florida. Coupled with ongoing environmental monitoring initiatives, these efforts will facilitate a regional sediment resource management perspective and support strategic planning and management of OCS sand resources.



Figure 15. Before and after Hurricane Sandy storm damages (Seaside Heights, New Jersey).

## 6.2 Conventional Energy Science Strategy

BOEM will continue to implement 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. Protected species have also been the focus of several important studies over the years, including the Cetacean and Turtle Assessment Program in the late 1970s and early 1980s, which helped define critical habitat for the North Atlantic Right Whale. All of these studies and more provide an important context for decision making related to the potential impact of offshore activities and development.

### 6.2.1 Biological

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 OCS activities. 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” (<http://oceanadapt.rutgers.edu/>) 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. A 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 EFH.

BOEM is actively coordinating with partners to develop a new studies initiative for deepwater exploration and research on the Mid- and South Atlantic OCS. The *Deepwater Atlantic Habitats II* study proposed for FY 2017 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. BOEM remains committed to understanding ecosystem dynamics in the Atlantic LMEs, including in deep waters where significant knowledge gaps remain. 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 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.

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. In FY 2015, the Atlantic Oil and Gas program added funds to the AMAPPS-II study to deploy several deepwater 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 has been working together with other federal and state agencies to obtain approval of Atlantic G&G permits for seismic surveying of oil and gas resources in the Mid- and South Atlantic Planning Areas. BOEM continues to actively disseminate the best available science to stakeholders regarding potential impacts of seismic surveys on living marine resources. A new study in FY 2018 will provide an analysis of the history of seismic surveys on the U.S. OCS in comparison to long-term indicators of ecosystem health to further inform G&G permitting on the Atlantic OCS. The objective of this study is to determine whether historical seismic survey activity on the U.S. OCS is quantifiably related to changes in long-term indicators of marine health and productivity, including in the GOM where decades worth of seismic and marine monitoring data exist.

### **6.2.2 Social Sciences and Economics**

The Mid- and South Atlantic marine ecosystem provides numerous services to both humans and the environment. There have been significant advances in the application of environmental valuation techniques to marine waters over the last decade. These studies have provided a means of quantifying the variety of services that different marine ecosystems around the world can provide. A study proposed in FY 2018 will provide an ecosystem services analysis for the Mid- and South Atlantic which considers the numerous services provided and better informs tradeoffs related to offshore development. Ecosystem services are traditionally divided into three categories, related to Provisioning services (*e.g.*, food, ornamentals, biotechnology, and energy), Regulating services (*e.g.*, clean water, biodiversity, coastal protection, and climate stability), and

Cultural services (e.g., sense of place, tourism and recreation, science and education, heritage). A major gap exists in the application of ecosystem service valuation to deep sea marine ecosystems, and this study will seek to fill that gap for the Mid- and South Atlantic planning areas.

## 6.3 Renewable Energy Science Strategy

### 6.3.1 Biological

#### *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 for surveys.

BOEM's avian research strategy also focuses 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. To better assess the collision risk to birds, BOEM is also interested in the movement patterns of birds around the soon to be completed Block Island Wind Farm through both a resurvey of the area off of Rhode Island and the use of nanotags to track specific species. In addition, nanotags will be placed on a number of species to evaluate movement during a variety of weather conditions especially conditions associated with poor visibility.

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](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 FY 2014.

- 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 and 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. A new study will be implemented to cover Red Knots in 2016 and will look at movement patterns during a variety of weather conditions.

### **Marine Fish**

The effects of renewable energy development on fish and shellfish range from physical modification of the seafloor habitat to behavior modification due to noise. Fundamental to

protecting fish species is an understanding of the physical habitat and the fish use of these habitats during particular times of the years and during crucial times during the animals' life history. It is important to understand this information not only at the project-level but at the level of the species range, and management levels. BOEM has invested resources in understanding high priority fish, locations, and impact producing factors. To date, high priorities have primarily been identified through Intergovernmental Task Forces, public meetings, formal information solicitations via the *Federal Register*, and recommendations made in BOEM-funded studies. In the Atlantic renewable energy program, BOEM has placed endangered and threatened fish species and commercially important fish species as a high priority. Within that group BOEM then evaluates the vulnerability of the species to BOEM approved activities. Species that BOEM has invested in to date include Atlantic sturgeon (occurrence and habitat use in offshore overwintering areas), American lobster in Southern New England (abundance and EMF impacts), Jonah crab (abundance), and skates (EMF impacts). High priority areas for study are driven often by the leasing and development timeframe and by studies that are providing baseline data on lease areas to determine if there are any habitats that may be sensitive to potential development impacts.

For example, 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. High priority impact producing factors that have been identified include EMF, physical habitat disturbance, and underwater sound. BOEM has invested in EMF studies in both the Pacific and Atlantic and has worked collaboratively with the DOE on assessing the effects of EMF to electro- and magnetic-sensitive species. Regarding physical habitat disturbance, BOEM has invested in baseline habitat surveys, regional circulation modeling, and has evaluated empirical data from European offshore wind facilities, studies conducted by BOEM's MMP, and data collected by lessees. Regarding noise and its impact to fish and invertebrates, BOEM has conducted a literature synthesis and held a comprehensive workshop with international experts on sound and impacts to fish and invertebrates. Data collected through baseline marine fish studies have allowed BOEM to identify priority species, such as black sea bass and longfin squid, that may be negatively impacted by construction and operational noise from offshore wind energy development.

### ***Marine Mammals***

Marine mammals on the Atlantic seaboard are generally highly migratory and use a wide amount of the outer shelf. As a result they may be impacted from all of BOEM's leasing programs. Thus studies of marine mammal abundance and distribution are handled across programs. These studies include surveys to determine distribution and abundance as well as the use of PAM to understand migration. In addition, the Renewable Energy Program is looking to acquire information to evaluate the risk from construction and operation activities, particularly effects from sound and vessel strikes. In particular, the use of a Dynamic Risk Assessment Model for Acoustic Disturbance which accounts for the movements of whales before, during and after noise exposure using ecological modeling is proposed. As a potential mitigation measure for sound effects from high resolution seafloor mapping, BOEM is evaluating the use of hydrophone arrays.

### ***Benthic Macroinvertebrates***

Benthic macroinvertebrates such as lobster and scallops are important commercial fisheries. BOEM is currently funding studies to evaluate benthic habitats in wind energy areas including the use of ventless traps for lobster. Initial results provide new insights into the use of the Southern New England wind energy areas by lobster. Additional work is necessary to further elucidate their movement patterns and will include the use of telemetry.

### **6.3.2 Social Sciences and Economics**

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. Along the Atlantic Coast, tourism and recreation is a significant contributor to local economies. The effects from offshore wind development are a common concern particularly from the visibility of the turbines. Establishment of a set of hypotheses for testing the effects is the first step in determining the associated impacts.

### **6.3.3 Information Management & Integrated Studies**

Studies to support the Renewable Energy Program within BOEM were first funded in 2007. Since that time, a large body of work is now available for use by the public. Unfortunately, simply making this information available on the web is not enough to get the word out. BOEM has a history of funding information transfer meetings to share information about ongoing and completed studies and to gather ideas for future studies. The Atlantic region has not had such a meeting in over 20 years and one focused on renewable energy is both timely and warranted.

## **6.4 Marine Minerals Science Strategy**

The long term strategy of the MMP is to develop a comprehensive understanding of the extent and quality of the sediment resources available in the OCS and the biological and physical drivers associated with each feature to better inform future management decisions. Broad BOEM MMP efforts in the Atlantic have focused on the large scale data collection undertaking known as the Atlantic Sand Assessment Project, which was initiated through the Hurricane Sandy response efforts. This initial inventory is the first step in facilitating regional resource management strategies. The MMP intends to expand these sand resource inventory investments into the GOM and isolated locations within the Pacific. As these data collection and processing efforts continue, the MMP GIS infrastructure will be a critical data management asset. Additionally, collection of existing sediment data, geophysical, dredging, and other offshore data by BOEM MMP from the states is being conducted and input into the MMP GIS to add to the body of knowledge that BOEM MMP has on the extent and nature of these resources. Access to this national data set by internal BOEM staff and external stakeholders will be an invaluable resource to support future coastal resiliency planning on a national scale.

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.

#### 6.4.1 Biological

Dredging in the OCS offshore of New England has been limited to date, due, in part, to the general perception that it may disrupt valuable fisheries. As large scale weather events and eustatic sea level rise continue to highlight the erosive trend on Atlantic beaches, an acceleration in offshore sand mining becomes more probable, even in the northeastern region. The surprising northern reach of Hurricane Sandy highlighted the need to plan for potential near-term beach nourishment projects in the northeast, which may require the utilization of OCS sediment resources. In order to prepare for effective management of these resources, the MMP is pursuing studies investments in the New England region to develop a comprehensive understanding and evaluation of the variability and extent of the biological assemblages that may be affected by proximal dredging, either directly or through the loss of the sand shoal habitat.

Specifically, the Northeast Regional Planning Body and the MMP are seeking to gain a more data driven, scientific understanding of how dredging may affect northeastern fisheries. This proposed study, *Assessing Biological and Oceanographic Processes that Drive Fisheries Productivity on New England Sand Shoals and the Potential for Dredging Related Disruption*, begins with an examination of the behavior of forage fishes such as the sand lance (*Ammodytes* spp.), and will examine the lifecycle of these fish as it relates to the sand shoal habitat. Understanding this will allow coastal managers to understand how dredging will impact the fish during the different stages of their lifecycle, so that it may be determined how dredging can be performed in a manner that would least impact the survivability, recruitment, and dispersal of the fish. These data will inform decisions on issues such as mitigations, dredging windows, habitat conservation, etc. The results of this study would support future ESA and EFH consultations and better inform the current perceptions regarding dredging impacts to commercial fisheries by evaluating the biological processes of productivity in sand shoal areas, and the associated risks to fisheries landings. This study further supports regional ocean planning by “identifying best dredging practices, and ways to minimize impacts” as well as working “to better engage the fishing industry through specific mechanisms and improved data” (Northeast Regional Planning Body 2016).

A second biological study, *BioGliders: Leveraging Marine Animals as Mobile Telemetry Sensor Networks*, is also proposed by the MMP for the Atlantic OCS, in the more heavily dredged southern waters. Along the coast of Florida, the MMP and the Studies Program have made a significant investment into improving our understanding of the use and recovery of offshore sand shoals by various trophic levels. Along with intensive sampling methods, acoustic telemetry has been used to understand the habitat utilization and movements of fishes. This telemetry affords considerable cost savings when compared to satellite and affords multi-scale movements analysis through network collaborations with acoustic arrays outside of the study area. Acoustic tags work by having an active ‘ping’ which is then received and logged by a receiver. Anchored receivers globally are logging movements of fishes from small salmon smolt to whale sharks. The stationary nature of receiver arrays means that if an animal does not pass through the array, data are unable to be gathered. Arrays can be extended mechanically by outfitting transceivers, devices that both transmit to other receivers and receive from tagged fish, to electronic, thermal, or wave powered gliders. The MMP is currently investing in such a glider to expand the

receiving area. Operating gliders to extend acoustic receiver arrays is cost intensive and does not shed information on inter-species behavior which can be impacted by BOEM activities. Thus it is being proposed that larger animals, such as manta rays and whale sharks, be leveraged as mobile observation networks. This can further improve coverage and make for a more cost effective solution to supplemental monitoring. Extending sensor arrays using large mobile megafauna (IOOS ATN 2016) enables observation of ecological interactions while understanding movements of tagged animals (Pittman, et al. 2014). 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. The data from this study will be used in BOEM's NEPA analyses and consultations on EFH.

## 6.5 Future Plans

### 6.5.2 Conventional Energy Future Plans

Baseline studies will continue to play an important role in the Atlantic to inform potential oil and gas exploration and development activities. 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, water quality, and physical oceanography, and will similarly be included in future Atlantic study plans, allowing for updated scientific methodologies, techniques, and sample collection. BOEM will continue to develop strong partnerships with other agencies that share its common goals and to leverage assets, including for the large research vessels and submergence facilities that are required for much of the offshore oceanographic and deepwater studies the Bureau will continue to pursue. Advanced technologies will continue to play a major role in obtaining long-term ecosystem measurements for the Mid- and South Atlantic, including use of fixed and mobile platforms, as well as tag telemetry, remote sensing, and advanced modeling technologies. BOEM will pursue sustained funding for the ADEON currently being developed to provide the long-term observations required for understanding potential impacts of various anthropogenic and natural stressors on the marine ecosystem. This observatory network, the AMAPPS program, and other planned initiatives will play an important role in understanding the marine soundscape and potential impacts of anthropogenic noise, such as from seismic surveys, on marine mammals distributions, abundance, and behavior.

### 6.5.3 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 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.

#### 6.5.4 Marine Minerals Future Plans

Much of the geologic and environmental research focus for FY 2017–2019 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 nm 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) quantify the unique functional ecosystem services of ridge-swale habitats in the South Atlantic Bight; (2) 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) 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.

Long term observations allow BOEM to identify the potential impacts of multiple sediment removal activities at repeat dredging locations and determine the extent, nature, and process of disturbance and recovery. As the MMP pursues a national sand resource inventory, information on recovery is necessary for improved regional management of offshore habitat availability for prey and fish species. This knowledge will improve effects analyses in NEPA documents and greatly focus and improve the outcomes of EFH consultations. As previously discussed, the MMP is proposing a companion FY 2017–2019 study effort at Ship Shoal in the GOM. Additionally, the MMP is interested in conducting a third companion effort in 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 Habitat Conservation Division has indicated interest in conducting a similar long term monitoring study in the Northeast region, within the vicinity of New Jersey, working in collaboration with the NMFS Sandy Hook, New Jersey field lab. Expanding this baseline monitoring of benthic and fish community use within ridge swale habitats offshore of New Jersey would complete the need for a comprehensive, robust, and consistent study design across the Atlantic and Gulf regions, and support future borrow area management decisions across a regional and national scale.

## REFERENCES

- BOEM. *Ongoing Environmental Studies*. 2016. <http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Current-Research.aspx> (accessed March 4, 2016).
- BOEM. *Outer Continental Shelf Oil and Gas Leasing Program 2017–2022: Draft Programmatic Environmental Impact Statement*. Environmental Impact Statement, Sterling, Virginia: Bureau of Ocean Energy Management, 2016, 873.
- BOEM. *Proposed Outer Continental Shelf Oil & Gas Leasing Program 2012–2017*. Government Report, Herndon, Virginia: Bureau of Ocean Energy Management, 2011, 200.
- DOI. *United States Department of the Interior Strategic Plan for Fiscal Years 2014–2018*. Government Report, Washington, D.C.: U.S. Department of the Interior, 2014, 56.
- EOP OMB. "Final Information Quality Bulletin for Peer Review." *Memorandum*. Washington, D.C.: Executive Office of the President, Office of Management and Budget, December 16, 2004. 45.
- IOOS ATN. *Animal Telemetry Network*. August 2016. [http://www.ioos.noaa.gov/observing/animal\\_telemetry/welcome.html](http://www.ioos.noaa.gov/observing/animal_telemetry/welcome.html) (accessed April 4, 2016).
- Northeast Regional Planning Body. *New England's ocean plan*. 2016. <http://neoceanplanning.org/about/northeast-rpb/> (accessed April 4, 2016).
- NRC. *Assessment of the U.S. Outer Continental Shelf Environmental Studies Program: III. Social and Economic Studies*. Edited by Kate Kelly. Washington, D.C.: National Academies Press, 1992.
- Pittman, Simon J., et al. "Fish with Chips: Tracking Reef Fish Movements to Evaluate Size and Connectivity of Caribbean Marine Protected Areas." Edited by Christopher J. Fulton. *PLoS ONE* 9, no. 5 (May 2014): 11.
- Russell, Robert W. *Interactions Between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico*. Final Report, Coastal Marine Institute, Louisiana State University, Baton Rouge, Louisiana: Minerals Management Service, 2005, 325.

## APPENDIX I. TABLES OF PROPOSED STUDIES FOR FY 2017 AND FY 2018

Table 1. National Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
84	MAQ	1	Use of Satellite Data for Offshore Air Quality Applications
86	PS	2	Demonstration Project, Integrating DNA Profiles, Genomics and Photo-Identification data
89	IMO	3	Connecting Stakeholders: Incorporating Citizen Science and Crowdsourcing into Decision Making
91	IMO	4	Symposium on Gulf of Mexico Oil Spill Science
93	IMO	5	Compendium on Gulf of Mexico Oil Spill Science
95	PS	6	Spatial & Acoustic Ecology of Pelagic Megavertebrates
98	BIO	7	Do structures used in BOEM Permitted Activities play a role in the spread of invasive Lionfish, <i>Pterois volitans</i> ?
101	AR	8	Nationwide Inventory and Analysis of Submerged Aircraft on the OCS
<b>Discipline Codes</b>			
AR = Archeological Resource Protection      BIO = Biology IMO = Information Management & Other      MAQ = Meteorology & Air Quality PO = Physical Oceanography      PS = Marine Mammals & Protected Species			

Table 2. National Studies proposed for the FY 2018 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
103	PS	1	Developing the Next Generation of Animal Telemetry: A Partnership To Develop Cost Effective, Open-Source, Marine Megafaunal Tracking
<b>Discipline Codes</b>			
AR = Archeological Resource Protection      PS = Marine Mammals & Protected Species			

Table 3. Renewable Energy Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
106	FE	1	Using Nanotags to Measure Shorebird and Bat Responses to Offshore Wind Turbines
108	FE	2	Fish Auditory Thresholds – Part 1
110	BIO	3	Southern New England Lobster Seasonal Movement
111	BIO	4	Understanding the potential for seabird displacement by offshore wind energy development
112	FE	5	Algorithm development to optimize localization accuracy of towed passive acoustic monitoring arrays used during offshore renewable energy activities
114	FE	6	Risk Analysis for Vessel Strikes on Whales from Offshore Wind Development Support Activities
116	PS	7	Remote Near Real-Time Detection of Marine Mammals in the Maryland Wind Energy Area
<b>Discipline Codes</b>			
BIO = Biology		FE = Fates & Effects	
PS = Marine Mammals & Protected Species			

Table 4. Renewable Energy Studies proposed for the FY 2018 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
118	FE	1	A dynamic risk assessment of acoustic impacts of wind farm development on North Atlantic right whales off the U.S. East Coast
120	FE	2	Fish Auditory Thresholds – Part 2
122	SSE	3	Evaluating Offshore Wind Energy’s Economic Impact to Tourism and Recreation
124	IMO	4	Information Transfer Meeting for Atlantic Renewable Energy Studies
126	BIO	5	Tracking Movements of a Suite of Priority Shorebirds Off the U.S. Coast to Better Understand Movements in Adverse Weather & Darkness
<b>Discipline Codes</b>			
BIO = Biology		FE = Fates & Effects	
IMO = Information Management & Other		SSE = Social Science & Economics	

Table 5. Marine Minerals Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
128	FE	1	Ecological Function and Recovery of Biological Communities within Sand Shoal Habitats within the Gulf of Mexico
131	BIO	2	Assessing Biological and Oceanographic Processes that Drive Fisheries Productivity on New England Sand Shoals and the Potential for Dredging Related Disruption
133	BIO	3	BioGliders: Leveraging Marine Animals as Mobile Telemetry Sensor Networks
<b>Discipline Codes</b>			
BIO = Biology		FE = Fates & Effects	

Table 6. Alaska Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
135	PO	1	Generation of Synthetic Audiograms by Applying Finite Element Modeling to CT Scans for Marine Mammals
137	IMO	2	Geospatial Mapping – A Geodatabase and Visualization Tool Set
139	PO	3	Wave and Hydrodynamic Modeling in the Nearshore Beaufort Sea
141	BIO	4	Wave Energy Converter Impact Assessment
143	BIO	5	Arctic Slope Winter Fish, Invertebrates, and Arctic Cod Spawning Survey
145	PO	6	Variability in Nearshore Buoyancy-Driven Circulation in the Beaufort Sea
147	PS	7	Identifying Sea Otter Abundance, Distribution, and Foraging Patterns in Cook Inlet Alaska, using Unmanned Aircraft Systems (UAS) and Manned Aircraft
149	BIO	8	Updating Status and Trends of Seabirds and Forage Fish in Lower Cook Inlet
151	SSE	9	Polycentric Governance in Barrow, Nuiqsut, and Wainwright
153	BIO	10	Marine Bird Distribution and Abundance in Offshore Waters
155	BIO	11	Foodweb Simulation Models to Connect Humans and Marine Mammals with Lower Trophic Organisms
<b>Discipline Codes</b>			
BIO = Biology		IMO = Information Management & Other	
PO = Physical Oceanography		PS = Marine Mammals & Protected Species	
SSE = Social Science & Economics			

Table 7. Alaska Studies proposed for the FY 2018 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
157	BIO	1	Extension of the Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring
159	PO	2	Enhanced Verification and Interpretation of Freeze-up Conditions for the Northeast Chukchi Shelf and Beaufort Sea OCS
162	FE	3	Assessment of Multiple Ocean Circulation Models to Support Ensemble OSRA Experiments
164	PS	4	Year-Round Marine Mammal Distribution in the Lower Cook Inlet Region
166	PS	5	Ice Seal Movements and Foraging: Village-based Satellite Tracking of Ringed and Bearded Seals (Extension)
168	SSE	6	Impact Assessment of Kaktovik Whaling Activities
170	IMO	7	Integration of Aerial Survey and Passive Acoustic Seasonal Distribution Data for Arctic Marine Mammals and Anthropogenic Noise Sources
172	PS	8	The View from Above: Continued Life-History Analyses of Bowhead Whales via Aerial Photo-Identification
<b>Discipline Codes</b>			
BIO = Biology		FE = Fates & Effects	
IMO = Information Management & Other		PO = Physical Oceanography	
PS = Marine Mammals & Protected Species		SSE = Social Science & Economics	

Table 8. GOM Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
174	MAQ	1	Gulf of Mexico Air Quality Study: Pollutant Transport, Atmospheric Dynamics, Monitoring and Modeling
177	BIO	2	Cumulative Impacts of Human Activity on Coastal and Marine Resources of the Gulf of Mexico
180	AR	3	GOM Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology & Archaeology Project II (GOM-SCHEMA II)
182	SSE	4	The Fiscal Impacts of the Gulf of Mexico OCS Industry
184	SSE	5	The Production and Distribution of Subsistence in Coastal Gulf of Mexico
186	IMO	6	Renewable Energy Potential Assessment for the Gulf of Mexico Outer Continental Shelf – Wind Energy Feasibility Study
188	BIO	7	Multibeam Survey of Small Topographic Features to Determine Efficacy of Current “No Activity Zones”
191	BIO	8	Gulf SERPENT for Deepwater Biological Observing: Synthesis of Historical Datasets and Continued Sampling
193	SSE	9	Support for Socioeconomic Impact Assessments of Offshore Energy Development in the Gulf of Mexico Region
195	AR	10	Interdisciplinary Research at the Site of Three 19 <sup>th</sup> Century Shipwrecks
197	SSE	11	Forecasting Helicopter Operations and Utilization in the U.S. Gulf of Mexico
200	FE	12	Characterization of Receiving Waters in the Gulf of Mexico
202	BIO	13	Baseline Monitoring of Avian and Bat Activity and Offshore Platform Interactions
204	SSE	14	OCS-Related Coastal Infrastructure Fact Book Update
206	SSE	15	Social and Economic Impacts of Outer Continental Shelf Activity on Individuals and Families: Sociocultural Monitoring
208	AR	16	Mapping the Late-Pleistocene Landscapes of the Gulf of Mexico through 3-D Seismic Analysis
211	AR	17	Archaeology and Coast in Crisis: Traditional Cultural Properties At Risk
214	SSE	18	Socioeconomic Impacts of OCS Infrastructure: Shifts in Recreational Behaviors
217	BIO	19	Effect of Oil Contamination on Wetland Loss
<b>Discipline Codes</b>			
AR = Archeological Resource Protection		BIO = Biology	
FE = Fates & Effects		IMO = Information Management & Other	
MAQ = Meteorology & Air Quality		SSE = Social Science & Economics	

Table 9. GOM Studies proposed for the FY 2018 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
219	MAQ	1	Tracer Experiments for Atmospheric Dispersion Modeling
221	SSE	2	Environmental Studies Program: Support for the Synthesis of Gulf of Mexico Region Socioeconomic Research
224	AR	3	Surveying and Testing Submerged Paleolandform Features in the Western Gulf of Mexico: The Sabine Pass Project
227	SSE	4	The Offshore Support Supply Vessel, Construction and Labor Market Industries in the Gulf of Mexico
229	FE	5	Preliminary Evaluation of the Mississippi Canyon Drum Disposal Site
231	SSE	6	Houston and New Orleans: Urban Centers, Urbanization, and the Gulf of Mexico Petroleum Industry
234	SSE	7	OCS-Related Transportation Infrastructure in Louisiana and Texas
236	PS	8	Supplemental Data Collection of GOM Marine Mammals using Citizen Science
237	AR	9	Archaeological Investigations of the <i>C.P. Baker</i> Shipwreck Site
239	SSE	10	Assessment of the OCS Leasing Program's Demographic Effects on the Gulf of Mexico Region
241	PS	11	Gulf of Mexico Deepwater Ecosystem Observatory Network (GODEON) – An Integrated System for Long-Term Monitoring of Ecological and Human Factors on the OCS
243	AR	12	Identification and Modeling of Wooden Shipwreck Remains in Pensacola Bay, Florida
245	PS	13	Cabled Observatory Feasibility Study Using the Gulf of Mexico Fiber Optic Network for Long-Term Ecosystem Monitoring in Offshore Waters
247	SSE	14	The Visual Impacts of OCS activities on Horn and Petit Bois Islands
<b>Discipline Codes</b>			
AR = Archeological Resource Protection		FE = Fates & Effects	
MAQ = Meteorology & Air Quality		PS = Marine Mammals & Protected Species	
SSE = Social Science & Economics			

Table 10. Pacific Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
249	PS	1	Seabird and Marine Mammal Surveys Near Potential Renewable Energy Sites Offshore Central and Southern California
252	PO	2	Exploration and Research for California Coastal and Ocean Renewable Energy (Cal CORE) I: Data Synthesis, Mapping, and Analyses
255	PS	3	Atlas of Main Hawaiian Island Seabird Colonies
258	PS	4	Pacific Marine Assessment Partnership for Protected Species (PACMAPPS)
260	FE	5	Pacific Regional Investigation Survey and Monitoring (PRISM)
262	FE	6	Understanding Biological Connectivity among Offshore Structures and Natural Reefs
264	SSE	7	Public Awareness and Perception of Offshore Wind Development in Hawai‘i
<b>Discipline Codes</b>			
FE = Fates & Effects		PO = Physical Oceanography	
PS = Marine Mammals & Protected Species		SSE = Social Science & Economics	

Table 11. Pacific Studies proposed for the FY 2018 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
267	PO	1	Exploration and Research for Hawai‘i Coastal and Ocean Renewable Energy (HI CORE) I: Data Synthesis, Mapping, and Analyses
269	PS	2	Pacific Seabird Monitoring Program
<b>Discipline Codes</b>			
PO = Physical Oceanography		PS = Marine Mammals & Protected Species	

Table 12. Atlantic Oil and Gas-Related Studies proposed for the FY 2017 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
272	BIO	1	Development of an Atlantis Model for the Mid- and South Atlantic OCS to Facilitate Strategic Planning and Cumulative Impact Evaluation
275	BIO	2	<i>Deepwater Atlantic Habitats II: Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities</i>
<b>Discipline Codes</b>			
BIO = Biology		PO = Physical Oceanography	
SSE = Social Science & Economics			

Table 13. Atlantic Oil and Gas-Related Studies proposed for the FY 2018 NSL.

Profile Page #	Discipline	Office Ranking	Study Title
277	IMO	1	History of Seismic Surveys on the U.S. OCS in Comparison to Long-Term Indicators of Ecosystem Health
279	BIO	2	Ecosystem Services Approach to Assessing the Impacts of Offshore Development in the Mid- and South Atlantic
<b>Discipline Codes</b>			
BIO = Biology		IMO = Information Management & Other	

**APPENDIX II. FY 2017-FY 2018 STUDY PROFILES ORGANIZED  
BY REGION**

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western and Central OCS planning areas (Gulf of Mexico), and Beaufort Sea (Alaska)

**Administered By:** Headquarters

**Title:** Use of Satellite Data for Offshore Air Quality Applications

**BOEM Information Need(s) to be Addressed:** To work with NASA's Atmospheric Chemistry and Dynamics Lab at Goddard Space Flight Center to assess the probability of use of satellite data for air quality applications, including assessing offshore oil and gas activities air quality impacts to the states as mandated by the Outer Continental Shelf Lands Act (OCSLA) for BOEM, to support BSEE's enforcement of hard to reach offshore platforms, and to better address the impacts of oil and gas activities in Environmental Assessments (EAs) and Environmental Impact Statements (EISs).

**Approx. Cost:** (in thousands) \$500      **Period of Performance:** FY 2017–2019

### **Description:**

**Background:** The 1990 Clean Air Act Amendments (CAAA) requires the U.S. Environmental Protection Agency (EPA) 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 EPA to periodically review the standards to ensure that they provide adequate health and environmental protection, and to update those standards as necessary. The EPA has set standards for six primary pollutants.

The OCSLA states that offshore oil and gas exploration, production, and development activities can't significantly impact the NAAQS of any state. As required per the regulations, BOEM is tasked with air quality impact assessments both pre-lease as a cumulative analysis for NEPA EIS, and post-lease as an individual plan review analysis. Satellites could be an essential tool to aid BOEM in these both these assessments.

As satellites have become better capable of evaluating the atmosphere, they have become increasingly capable of identifying and measuring the quantity of certain NAAQS pollutants. Although this capability has been identified, it has not yet been employed in the offshore environment.

**Objectives:** The purpose is to conduct a scoping study of the usage of satellites to support BOEM air quality in their NEPA process and impact assessments and BSEE in their enforcement activities. Specifically this scoping study would determine the feasibility of using satellites in offshore environments for:

1. Estimating ground level concentrations of NAAQS pollutants with no monitors,
2. Monitoring long term trends of the ground level concentrations of NAAQS pollutants,

3. Validating modeling results at the multiple vertical layers,
4. Identify the pollutant concentrations in areas surrounding the largest emission sources, relative to the quantity of inventory estimates.

**Methods:** The study will entail a partnership with NASA to improve the present state of the satellite data processing to derive estimates for the NO<sub>2</sub> pollution offshore. The operational global Ozone Monitoring Instrument (OMI) NO<sub>2</sub> product relies on some parameters that are only available at coarse resolution. For smaller domains, higher-resolution inputs (*e.g.*, *a priori* NO<sub>2</sub> profiles, surface reflectivity) will be created to improve results of the standard satellite data. In addition, new improvements to the processing algorithms can detect smaller signals than are typically detected by the operational algorithm. With an improved OMI NO<sub>2</sub> product, the study will 1) estimate the NO<sub>2</sub> concentration around offshore facilities 2) determine the contribution of onshore emissions (*e.g.*, specific refineries, power plants, and cities) to offshore air quality by analyzing wind flow patterns and daily OMI NO<sub>2</sub> data; 3) derive long-term trends over the last decade; and 4) use days with onshore flow to explore the magnitude and trends of offshore sources. Field observations using NASA equipment and aircraft will be used to validate the satellite products for an example an offshore facility that is a significant source.

**Revised Date:** March 30, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** National

**Administered By:** Headquarters

**Title:** Demonstration Project, Integrating DNA Profiles, Genomics and Photo-Identification data

**BOEM Information Need(s) to be Addressed:** Numerous types of studies have been conducted on cetaceans in the U.S. outer continental shelf (OCS), leading to challenges in the analysis and synthesis of diverse datasets, particularly those from long-term studies of populations exposed to anthropogenic impacts. The Marine Mammal Protection Act, National Environmental Policy Act and the Endangered Species Act require BOEM to consider the impacts of energy and mineral extraction activities on cetaceans. Together with others, BOEM has funded many studies where a number of groups have collected biopsy samples for genetic analyses and photographs for individual identification. In addition, many cases of OCS research across program areas and regions included satellite telemetry for studies of habitat use. For example, over the last decade, several publications and reports (*e.g.*, Sperm Whale Seismic Study [SWSS]) refer to collecting large numbers of biopsy samples and photo-identification records and more have been collected. DNA profiles and photo-identification records are increasingly used for defining units of management and for estimating abundance and trends in populations using capture-recapture models. To date, however, there is no catalogue of individual identity for a population or accessible archive that integrates DNA profiles and photo-identification. A Web-based, distributed-access data archive compatible with the Ocean Biogeographic Information System – Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) format can consolidate this data. This type of effort will enable and guide new analyses to inform future management questions regarding cetacean populations, including abundance, range, distribution, and stock identity. A similar information need has been recognized by the Office of Naval Research in their funding of the development of the *geneGIS* (<http://www.genegis.org/>) tools for the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) program on humpback whales in the North Pacific. However, although there are different groups working on including genetics in population assessments such as, for example, GOM Sperm Whales, there is currently no mechanism to centralize/unite these various efforts.

Information needs met by this study include standardization and archiving of DNA profiles from past and ongoing studies, *e.g.*, mtDNA haplotypes for maternal lineages, sex identification and microsatellite genotypes for individual identification. The DNA profiles derived from multi-locus genetic markers are typically laboratory specific and their format is not compatible with public genetic archives such as GenBank® (<http://www.ncbi.nlm.nih.gov/genbank/>). This project will increase management effectiveness and improve estimates of abundance based on either photo-identification or genotype capture-recapture, complementing the conventional use of genetic markers for describing stock structure. Life history parameters based on mortality can also be derived from capture-recapture models. Visual exploration and spatial analyses of

individual-based records from DNA profiles and photo-identification records will be improved. This enables investigators and managers to better understand the population structure and abundance as well as mortality events

This proposed project ties-in closely with existing efforts to monitor cetacean ecology in the GOM, Alaska and Atlantic regions, by creating a database framework that affords a directory to biological sample analysis across varying studies using a common Web framework. Information obtained will ensure that BOEM complies fully with environmental regulation and considers the impacts of its programs on these endangered species, while building capacity for further study by other BOEM regions using the same infrastructure.

**Approx. Cost:** (in thousands) \$350

**Period of Performance:** FY 2017–2019

**Description:**

Background: A growing number of large-scale studies of marine mammals and other marine megafauna (*e.g.*, sharks, and turtles) are collecting spatially explicit records linked through individual identification to genetic samples, photo-identification and telemetry. These spatio-temporal records have been used to track the migration and life history parameters of individuals, to estimate the abundance and trends of populations and, in the case of genetic markers, to infer close kinship (*e.g.*, parent/offspring relationships) and define management units, or Distinct Population Segments. The skin and blubber biopsy samples collected for genetic analyses are also used for assaying a growing number of ecological markers (*e.g.*, stable isotopes, fatty acids) and environmental contaminants (*e.g.*, Persistent Organic Pollutants, heavy metals). To date, however, there has been a conspicuous absence of integration and spatial exploration of individual genetic and photo-identification records; in particular, there is a need for linking photo-identification to genetic information (*e.g.*, DNA profiles).

An integrated database of photo-identification and DNA profiles can be used to manage OCS resources by, a) aiding in long-term monitoring of population health, b) enabling easy, open access to data for conducting analysis to support environmental impact statements and c) accounting for more accurate geographic analysis of DNA biopsy samples. This is essential for monitoring habitat use, assessing environmental threats, and defining appropriate listing levels for species exposed to exploration and development. This benefits BOEM by providing the potential for improved estimates of abundance and mortality/survival based on capture/recapture analyses using existing photo-identification and DNA profiles. This, along with improved genetic information on stock identity, can be used to estimate population losses. Additionally, this will develop a data archiving model that can be adopted nationally. The software architecture of the online archive could also provide tools for primary analyses and visualization of spatial-temporal records, linked through individual identity and genetic markers, as well as export functions for more specialized programs. Web-based databases are the solution for extending the range of analyses in space and time, standardizing data formats to ensure long-term archive utility, offering a cost-effective data-management solution for individual researchers that robustly provides the analysis functions they require, and encourages collaboration among diverse groups of

investigators, thus helping establish community standards for these ongoing studies of long-lived species.

**Objectives:** The objective of this study is to improve the current computation capabilities for integrating DNA profiles with photo-identification records for assessment and long-term monitoring of marine mammal populations. To provide a standardized database architecture for online access, with associated tools for primary analyses and visualization of spatial-temporal records. An important component of this objective is to develop 'community standards' that can be applied across multiple species, as well as multiple investigators, and that promotes data sharing and archiving. The development of a Web-based, collaborative collection could form a model for similar developments with other species of interest to BOEM.

**Methods:** A Web-based, user-friendly computational framework for accessing integrated DNA profiles and photo-identification records, compatible with the OBIS-SEAMAP, will be developed. Associated computational tools for data exploration and export to specialized programs will also be developed. The proposed work will include organizing a workshop of Federal partners, academic researchers and other potential contributors to the databases, to encourage participation in the data archive and promote collaborative research. Data format commonalities and/or conversion needs will also be determined.

**Revised Date:** March 29, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** National

**Administered By:** Headquarters

**Title:** Connecting Stakeholders: Incorporating Citizen Science and Crowdsourcing into Decision Making

**BOEM Information Need(s) to be Addressed:** Regulatory drivers such as the Marine Mammal Protection Act, Endangered Species Act, National Marine Sanctuaries Act, and the National Environmental Policy Act require BOEM to consider the impacts of regulated activities on protected species and their habitats. Assessing the potential impacts from BOEM permitted activities related to conventional and renewable energy development on the health and site fidelity of marine mammals and other megafauna is essential to support BOEM's environmental compliance and impact analysis.

**Approx. Cost:** (in thousands) \$680

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** BOEM's regulatory mandates direct using the best available science in determining impacts of planned activities on environmental resources. However, both the national cataloging of Citizen Science data and the need for a standardized statistical framework for analysis present challenges for inclusion of the large amount of existing marine megafauna sightings data. Furthermore, White House Council on Environmental Quality (CEQ) memorandum of September 30, 2015, directs federal agencies to accelerate Citizen Science (<https://www.whitehouse.gov/blog/2015/09/30/accelerating-use-citizen-science-and-crowdsourcing-address-societal-and-scientific>) and better incorporate that science into agency decision making. Through Citizen Science, the public participates voluntarily, addressing real-world problems by collecting and analyzing data, interpreting results and solving complex problems. This can greatly aid in providing fresh perspectives and solutions to BOEM's environmental monitoring challenges. Crowdsourcing affords an opportunity to submit an open call for voluntary assistance from a large group of individuals to assist in the management of data quality. Combining Citizen Science and crowdsourcing can significantly expand BOEM's ability to cost effectively conduct robust scientific analysis while improving opportunities for stakeholder engagement.

Currently, data used to support impact assessment comes from various distribution models, standardized surveys and other studies such as Atlantic Marine Assessment Program for Protected Species (AMAPPS). Citizen science initiatives exist throughout the U.S. to document marine mammal and protected species, however, current initiatives don't contribute to a central, easily query'able databases for impact analysis. Additionally, the statistical tools to incorporate this science into robust environmental analyses remain underdeveloped. Long term analysis of Citizen Science sightings and photographs can provide insight into changing health and fitness of cetaceans as ecosystem sentinels. Partnering with National Marine Sanctuaries' (NMS') volunteer Whale Alert Network, for example, can enhance the contribution of BOEM's

Environmental Studies Program to build and engage a constituency for ocean science nationwide. In addition, stakeholders and the public have more confidence in the results from research in which they participate. Citizen science and, furthermore, crowdsourcing, enable BOEM to enhance scientific understanding of potentially impacted resources and address agency needs, while drawing on the historically underutilized resource of Citizen Science. Simply put, leveraging Citizen Science for BOEM needs can yield comprehensive science while making the most of limited resources.

**Objectives:** This study will seek to incorporate existing ocean Citizen Science initiatives into BOEM analyses by a) Enhancing our understanding of existing species habitat distribution by incorporating Citizen Science data to better calculate take estimates and conduct impact analysis; b) Contribute to dynamic/adaptive management of marine mammal habitat by partnering to expand the national Whale Alert network to include areas of BOEM permitted activities; c) Ensure national oceanic Citizen Science data is query'able in the Ocean Biogeographic Information System (OBIS) database. d) Ensure sustained long-term community engagement through existing Citizen Science efforts.

**Methods:** Enhancing our understanding of existing species habitat distribution will be accomplished through the development of presence only statistical models, as well as developing two classes of models (scr and occupancy) for species for which these types of opportunistic data exist in order to get baseline or 'without opportunistic sightings' results. Incorporate the unstructured data and conduct a formal evaluation of the value of Citizen Science data when collected within the spatio-temporal domain of planned studies. Provide some simulations for spatial design of citizen sightings. Specifically, once the benefit of adding such data is known, it will be possible to suggest how much effort would result in improvement in estimates of state-variable (abundance, occupancy, *etc.*), but also, where additional sampling could take place to target areas for increasing engagement and participation. The above objective to contribute to adaptive management will be accomplished by partnering to expand the national Whale Alert network by funding additional development of the existing mobile app to include BOEM areas of concern such as active sand shoal dredge sites. Leveraging partnerships to ensure standardized management of data quality will unite existing Citizen Science networks to maximize effectiveness. Data quality will be addressed in a multi-tiered classification system where only data which meets the highest caliber, through both quality assurance and quality control initiatives, will be accepted for analysis. Sustained long term participation, by leveraging the federal Citizen Science toolkit and using proven engagement practices, will ensure these tools remain useable for the long term beyond the funding period. Outreach will take the form of an online gaming interface to provide many of the features that make for successful long term engagements and through collaborative outreach efforts with government and non-governmental organization (NGO) partners.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Gulf of Mexico

**Administered By:** Headquarters and Gulf of Mexico OCS Region

**Title:** Symposium on Gulf of Mexico Oil Spill Science

**BOEM Information Need(s) to be Addressed:** The Bureau of Ocean Energy Management's (BOEM) National Environmental Policy Act (NEPA) analyses and consultation documentation need to be informed by the latest scientific data. Following *Deepwater Horizon (DWH)*, various entities have worked to examine impacts to the Gulf of Mexico's ecosystems. BOEM needs to review and synthesize the results from these studies and any ongoing efforts in order to meet our mission of promoting energy independence, environmental protection, and economic development through responsible, science-based management of offshore resources. When considering potential leasing areas, BOEM's NEPA analyses evaluate potential impacts to resource areas by comparing possible alterations to a resource to known baseline data. A compendium is being proposed that will proactively analyze any shifts to subject area baselines that may have occurred following *DWH*. The results of that research synthesis and baseline analysis will support future BOEM decision documents on the utilization of these offshore resources. This follow on study will provide BOEM with a venue for focused information sharing and discussion with scientific panelists involved in the research to be identified in the compendium.

**Approx. Cost:** (in thousands) \$250

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** On 20 April 2010, the *DWH* drilling rig operating approximately 50 miles (80 km) off the coast of Louisiana experienced a catastrophic failure that resulted in the release of petroleum (oil and gas) and subsequent explosion and fire, loss of human lives, the ultimate sinking of the rig, and a discharge of gas and light sweet crude oil from an ocean depth of nominally 5000 feet (1525 m). The large oil and gas volumes released during the spill are part of a series of petroleum-related impacts suffered by the Gulf of Mexico, including the IXTOC I spill in 1979, the large-scale oil spillage during Hurricanes Katrina and Rita, and the chronic annual releases due to ship activity, industry activity, and human use. Following the spill, a rush of scientific research began including multiple venues of funding (e.g., NSF RAPID, GoMRI, and others). The impetus of this research was to investigate the impacts of the oil and dispersants on the ecosystems of the Gulf of Mexico to improve our understanding of the dynamics of such events and their environmental and public health implications. In addition, there is an annual conference, the Gulf of Mexico Oil Spill and Ecosystem Science Conference, that allows researchers to present their results.

To date a wide range of research topics have been explored by various agencies and academic institutions. These topics include analyses of the efficiency, fate, and impacts of dispersants; the impacts to and recovery of salt marshes, deepwater corals, cultural resources, marine mammals, and plankton; along with research in many other chemical,

biological, physical, and social/cultural impact areas. Some of this research has already been made public and some is only recently becoming available following the completion of the Natural Resource Damage Assessment (NRDA) process. BOEM needs to consider this relevant research as the agency responsible for ensuring that the effects on the natural and human environment are taken into consideration during the leasing and development of oil and natural gas on the Outer Continental Shelf. Considering the wide range of research topics to be reviewed following the spill there are considerable challenges associated with reviewing, analyzing, and applying these data in our NEPA analyses. A synthesis of the research to date, associated with the *DWH* spill, would greatly lessen this challenge and enable BOEM to meet our responsibilities of managing offshore energy while considering the potential impacts.

**Objectives:** The overall objective of this effort is to coordinate the logistics for and facilitate a symposium that examines the current state of the Gulf of Mexico ecosystem and social dimensions following the *DWH* spill event. Building upon a compendium of current literature to be developed through a related study, the symposium will create an opportunity for focused information sharing among researchers, academics, and state and federal agencies. Understanding how the Gulf of Mexico ecosystem may have changed as a result of *DWH* will aid BOEM in conducting future NEPA analyses and consultations.

**Methods:** The contractor will conduct a symposium with participation by state and federal agencies, including BOEM and NOAA, as well as scientists conducting research in the Gulf of Mexico both pre- and post-*DWH*. This symposium is meant to be a focused discussion on areas of specific interest to BOEM. A panel will lead the discussion in each resource area with brief presentations and engaging discussions on the areas themselves and any potential data gaps. The proposed budget will cover the costs to acquire a venue and conduct the workshop; form a scientific advisory committee for the symposium and agenda development; identify key participants, organize equipment rental; and prepare the symposium proceedings. The symposium will be held in Fall 2017.

**Revised Date:** April 11, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Gulf of Mexico

**Administered By:** Headquarters and Gulf of Mexico OCS Region

**Title:** Compendium on Gulf of Mexico Oil Spill Science

**BOEM Information Need(s) to be Addressed:** The Bureau of Ocean Energy Management's (BOEM) National Environmental Policy Act (NEPA) analyses and consultation documentation need to be informed by the latest scientific data. Following *Deepwater Horizon (DWH)*, various entities have worked to examine impacts to the Gulf of Mexico's ecosystems. BOEM needs to review and synthesize the results from these studies and any ongoing efforts in order to meet our mission of promoting energy independence, environmental protection, and economic development through responsible, science-based management of offshore resources. When considering potential leasing areas, BOEM's NEPA analyses evaluate potential impacts to resource areas by comparing possible alterations to a resource to known baseline data. This study will proactively analyze any shifts to subject area baselines that may have occurred following *DWH*. The results of the research synthesis and baseline analyses will support future BOEM decision documents on the utilization of these offshore resources.

**Approx. Cost:** (in thousands) \$150

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** On 20 April 2010, the DWH drilling rig experienced a catastrophic failure that resulted in the release of petroleum (oil and gas) and subsequent explosion and fire, loss of human lives, the ultimate sinking of the rig, and a discharge of gas and light sweet crude oil from an ocean depth of nominally 5000 feet (1525 m). Following the spill, a rush of scientific research began including multiple venues of funding (e.g., NSF RAPID, GoMRI, and others). The impetus of this research was to investigate the impacts of the oil and dispersants on the ecosystems of the Gulf of Mexico to improve our understanding of the dynamics of such events and their environmental and public health implications.

To date a wide range of research topics have been explored by various agencies and academic institutions. These topics include analyses of the efficiency, fate and impacts of dispersants, the impacts to and recovery of salt marshes, deepwater corals, cultural resources, marine mammals, and plankton along with research in many other chemical, biological, physical, and social/cultural impact areas. Some of this research has already been made public and some is only recently becoming available following the completion of the Natural Resource Damage Assessment (NRDA) process. BOEM needs to consider this relevant research as the agency responsible for ensuring that the effects on the natural and human environment are taken into consideration during the leasing and development of oil and natural gas on the Outer Continental Shelf. Considering the wide range of research topics to be reviewed following the spill there are considerable challenges associated with reviewing, analyzing and applying these data in our NEPA analyses. A synthesis of the research to date, associated with the DWH spill, would

greatly lessen this challenge and enable BOEM to meet our responsibilities of managing offshore energy while considering the potential impacts.

Objectives:

- Synthesize current scientific understanding of chemical, biological, physical, and social/cultural impacts related to the current state of the Gulf of Mexico ecosystem following the *DWH* spill event. Understanding how the Gulf of Mexico ecosystem may have changed as a result of *DWH* will aid BOEM in conducting future NEPA analyses and consultations.
- Identify relevant areas, space, and time scales for study, cost-effective research methods, costs, and cost-leveraged study opportunities to develop appropriate duration datasets to address the critical gaps in understanding.
- Utilize existing technology for sharing of the current science and data amongst academic, Federal, and State researchers.

Methods: The contractor will conduct a survey of all published literature related to chemical, biological, physical, and social/cultural impacts related to the *DWH* spill and response activities and then summarize findings from studies (BOEM and non-BOEM) by resource area. Methods proposed for this study include literature research, data mining, surveying and synthesis, comparative analysis, and stakeholder coordination. The contractor will synthesize these data into a compendium with sections on the different resource areas that BOEM considers in our NEPA analyses such as spill impacts on marine mammals, birds, water quality, *etc.* Each section will summarize the research as best known at the time of the publication. Each section will also analyze any potential data gaps that occur within the resource area. The compendium will consider if there has been a baseline shift within the resource area and, if so, in what way have the impacts shifted the baseline and what are the future prospects for this shift (is it still undergoing change).

This project will utilize a previous BOEM study, the EcoSpatial Information Database (ESID). ESID is a searchable database with a map interface of georeferenced ecological information resources and associated data to support ecosystem-based management of activities permitted by BOEM. The ESID will hold copies of all published works cited in the compendium, serving as a local copy for BOEM analysts to discover and access any relevant literature. Also, the ESID will reference authoritative data holdings available from NOAA and other sources, as well as make select datasets available to BOEM and the public in support of NEPA analysis.

**Revised Date:** April 11, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** National

**Administered By:** Headquarters

**Title:** Spatial & Acoustic 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. BOEM is required to design and implement mitigation measures to reduce or eliminate impacts from regulated activities on protected and managed species, which is challenging due to a lack of data on infrequently observed, cryptic species. Deep-diving, acoustically sensitive cetaceans (*e.g.*, beaked whales) and poorly sampled species, such as sei whales, are just such creatures, and they inhabit the shelf and shelf-break waters of virtually every area BOEM manages. The lack of information about their diving behavior and acoustic ecology creates a high degree of variability in their detection probabilities and the analysis of data from passive acoustic monitoring (PAM), which is one of BOEM's primary mitigation and monitoring tools. Verifying cue rates (*i.e.*, a key for PAM analyses) for understudied marine mammals in diverse behavioral states and habitats is thus key in reinforcing BOEM passive acoustic studies nationally. BOEM requires robust, current data to (1) fully analyze and disclose the potential for significant impact from OCS activities at the programmatic and site-specific level pursuant to NEPA, (2) to enable us with the ability to ensure that a species is not jeopardized by an activity or that critical habitat is not adversely modified by that activity pursuant to the ESA, (3) to minimize incidental take of marine mammals stemming from BOEM-permitted activities, thus meeting not only the small numbers and negligible impact requirement under the MMPA but also making every effort to maintain the health and stability of marine mammals and their ecosystem, and (4) to fulfill assessment and consultation requirements under the with other federal agencies. This study will ensure BOEM acoustic monitoring, a vital cross programmatic tool, is based on the best available science.

**Approx. Cost:** (in thousands) \$2,400      **Period of Performance:** FY 2017–2019

### **Description:**

**Background:** Detection probability, the likelihood of a species being detected in a given survey method, is a pervasive challenge to the application of marine mammal field data. Acoustic and visual surveys are heavily relied upon by BOEM and partners to estimate species abundances for impact analysis. In some species, such as the sei whale, acoustic behavior is calculated by very infrequent observations, leading to a significant amount of uncertainty in these lesser observed species. Furthermore, understanding the depth ranges and behavioral states at which marine mammals are vocalizing can provide important behavioral information and help interpret PAM datasets.

Numerous studies suggest cetaceans, particularly deep-divers such as beaked and sperm whales, may be disturbed or injured by intense sound sources. Several species of cetaceans occur in each of the program areas whose acoustic behavior, particularly cue rates, as it relates to habitat usage is poorly understood.

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. Variations in detectability result in significant data gaps in the distribution/occurrence of these species, which impairs BOEM's abilities to assess the potential impacts of acoustic disturbance from BOEM-regulated activities. This study will improve our understanding and application of the detection probabilities of these deep diving animals.

This study will support accuracy improvements to future as well as existing efforts such as Atlantic and Gulf of Mexico Marine Assessment Program for Protected Species (AMAPPS/GoMMAPPS). In doing so this study will provide necessary information for planning and compliance with environmental regulations.

**Objectives:** The objectives of this study are to: a) Describe site behavioral and acoustic ecology of understudied cetaceans where significant data gaps in cue rates exist; b) Describe acoustic, behavioral, and foraging ecologies of pelagic deep diving cetaceans; c) Update uncertainty analysis for OCS cryptic species to inform planning and mitigation design; d) Verify and/or establish cue rates to inform accurate density modeling of data deficient marine mammal species applicable to multiple BOEM programs and regions for impact analysis.

**Methods:** Due to the costs associated with traditional vessel survey time, this study will use an integrated, multi-platform approach for obtaining data that will be crucial for BOEM decision-making processes. This project will utilize two primary, proven methods: (1) Vessel mobile passive acoustic monitoring (PAM) and (2) Animal tagging. To maximize cost effectiveness, this project will initially use mobile (*i.e.*, tag, vessel and AUV-based) PAM, which, in addition to providing key data of its own, will also supplement existing Navy/NOAA fixed archival PAM units supported by the AMAPPS project. Together these techniques will accomplish at least three goals: i) record, classify and localize cetacean calls; ii) collect and verify cue rates using acoustic tagging combined with visual behavioral observation and towed PAM; iii) aid in validating acoustic propagation models by having multiple receiving nodes operating simultaneously. Utilizing a state of the art sailing vessel designed specifically for surveys (visual and acoustic) will allow many days at sea (90/year), which will provide robust temporal and spatial coverage. Also, importantly, vessel and AUV-based PAM will provide ground truth and guidance for the PAM buoys (*e.g.*, vocalization rates), which are nationally critical for long-term use of PAM techniques for mitigation and monitoring of industrial activity. Electronic tags such as satellite linked position tags and 3-D 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 acoustic behavior. Such tagging strategies have provided superb data for a

variety of marine mammal species and the techniques and technologies are readily available so can be easily and cost effectively deployed.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Headquarters

**Title:** Do structures used in BOEM Permitted Activities play a role in the spread of invasive Lionfish, *Pterois volitans*?

**BOEM Information Need(s) to be Addressed:** Regulatory drivers such as the Nonindigenous Aquatic Nuisance Prevention and Control Act as well as Executive Order 13112 require federal agencies to prevent the introduction of invasive species; detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; as well as monitor invasive species populations accurately and reliably. In compliance with the U.S. regulatory framework, this study proposes to assess the impact of BOEM permitted activities on lionfish dispersion and invasion success across each of the BOEM program areas as well as, if appropriate, investigate potential control mechanisms and develop a lionfish response plan. The data gathered through this study will provide information to BOEM and other government agencies regarding whether this species needs to be controlled or eradicated, and on what time scale to inform future cost-effective mitigation policies.

**Approx. Cost:** (in thousands) \$470

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** BOEM permitted activities such as the construction of platforms/turbines, installation of pipelines/MET towers, and sand mining all lead to some level of habitat disturbance; however the impact of this disturbance on the dispersal and invasion success of lionfish is largely unknown. Native to the Indo-Pacific, lionfish are now being established along the southeast coast of the U.S., Caribbean, and in parts of the Gulf of Mexico. Lionfish are of high concern to BOEM because they exhibit a high affinity for artificial structures and are commonly associated with oil platforms, MET towers, pipelines, and other hardened structures. Given the high number of artificial structures, it is possible that lionfish biomass may be higher in the Southeastern United States (SEUS) region than other regions thus worsening the invasion throughout the U.S. east coast. Artificial structures are known to facilitate invasive species introductions and establishment by providing new unoccupied habitat and creating corridors for further dispersal and expansion (Glasby *et al.*, 2007; Sheehy and Vik 2010). Construction of structures that provide new habitat are also identified as probable vectors for the spread of invasive species (Wasson *et al.*, 2005; Tyrrell and Byers 2007). Artificial reefs with vertical hard substrate provide surface area, creating habitat for marine organisms, including invasive species. As artificial reefs are often located in areas lacking hard bottom habitat, they typically provide unoccupied substrate for colonization (Wasson *et al.*, 2005; Tyrrell and Byers 2007; Sheehy and Vik 2010). Nonindigenous species are recognized as a major threat to ecosystem integrity if they become invasive. BOEM past studies have investigated the distribution of invasive invertebrate species, but BOEM permitted activities as a vector for lionfish dispersal has not been investigated. Given the high degree of invasiveness of lionfish, and their high affinity for disturbed and/or

new structures and environments, BOEM permitted activities are likely to facilitate the dispersal and further ecological impact of this nuisance species. BOEM is delayed compared to other DOI bureaus in addressing the issue of lionfish and has yet to develop a lionfish response plan. Because lionfish are a venomous species (Vetrano *et al.*, 2002) oil and gas industry divers working in proximity to this species pose a significant and predictable safety risk. Interactions are being recorded by the Occupational Safety and Health Administration, and it needs to be understood if this threat will increase because of BOEM permitted activities. As lionfish densities continue to increase on BOEM permitted structures, so will the incidence of envenomation of working divers.

**Objectives:** This study will a) characterize the role of pile driving, MET towers, oil/gas platforms and selected dredge sites on the lionfish invasion by measuring distribution, recolonization rates, and population-class of species distribution, and b) develop a lionfish response plan based on the results of this study.

**Methods:** This study will characterize the role of pile driving, oil/gas platforms and selected dredge sites (herein referred to as permitted sites) on the lionfish invasion in the Atlantic and northern Gulf of Mexico. The density, size distribution, and ecological impacts of lionfish will be assessed in permitted sites and as a comparison, relevant reference sites. Ecological impacts will be assessed through lionfish diet analysis and consumption modeling using the NOAA Lionfish Bioenergetics Model. If permitted sites are preferred habitat for lionfish, then these structures will have more and larger lionfish than comparison reference sites. However, if permitted sites are not preferred but facilitate lionfish dispersal, then permitted sites further offshore should have more and larger lionfish than their respective reference sites. These hypotheses will be tested against the null hypotheses that lionfish preference and dispersal is not affected by habitat modified by BOEM permitted activities (and thus there will be no difference between permitted and reference sites). To assess recolonization, isolated structures will be selected (defined as no lionfish visually present within 1 km based on ROV transects), and all lionfish will be removed. The site will then be monitored monthly to determine the rate of recolonization as well as the age structure of the colonizers. Sites may be colonized by larval fish dispersing from breeding areas, juveniles, or adults. This life history strategy will be important to understand, as potential future mitigation options will depend on the nature of the colonizing event. Given that lionfish depth range outside the bounds of safe SCUBA diving, Challenge.gov will be used to foster a competition for an open-source, cost-effective method to sample lionfish using an ROV. Development of a lionfish response plan will be completed in coordination with BSEE, DOI, NOAA and NGO experts.

## **References:**

Côté IM, Akins L, Underwood E, Curtis-Quick J, Green SJ. (2014) Setting the record straight on invasive lionfish control: Culling works. *PeerJ PrePrints*2:e398v1 <https://doi.org/10.7287/peerj.preprints.398v1>

- McCreedy, C., C. A. Toline, and V. McDonough. 2012. Lionfish response plan: A systematic approach to managing impacts from the lionfish, an invasive species, in units of the National Park System. Natural Resource Report NPS/NRSS/WRD/NRR—2012/497. National Park Service, Fort Collins, Colorado.  
[http://www.nature.nps.gov/water/marineinvasives/assets/documents/Lionfish\\_Response\\_Plan\\_final\\_small.pdf](http://www.nature.nps.gov/water/marineinvasives/assets/documents/Lionfish_Response_Plan_final_small.pdf)
- Sheehy, D. and S.F. Vik. 2010. The role of constructed reefs in non-indigenous species introductions and range expansions. *Ecological Engineering* 36:1-11.
- Vetrano, S.J., Lebowitz, J.B., Marcus, S., 2002. Lionfish envenomation. *The Journal of Emergency Medicine*. 23, 379-382.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** National

**Administered By:** Gulf of Mexico OCS Region

**Title:** Nationwide Inventory and Analysis of Submerged Aircraft on the OCS

**BOEM Information Need(s) to be Addressed:** Submerged aircraft are types of cultural resources that have been predominately overlooked in Federal offshore resource planning. BOEM’s databases have little consolidated information concerning the loss of historical aircraft within Federal waters. An inventory, overview, and repository of general information regarding these resources will assist BOEM in the planning and mitigation for these types of historic and cultural resources. They would also help BOEM complete its assessments under the National Environmental Policy Act (NEPA) and adhere to Section 106 and Section 110 requirements under National Historic Preservation Act (NHPA). Many of these resources are also protected under the Sunken Military Craft Act. The data and information will be most beneficial for BOEM’s post-lease NEPA analyses to ensure the protection of these cultural resources.

**Approx. Cost:** (in thousands) \$300

**Period of Performance:** FY 2017–2020

### **Description:**

**Background:** According to the National Park Service (NPS), “much of America’s 20<sup>th</sup> century history is inextricable linked to aviation. At times, American inventors, scientists, engineers, pilots, and military and civilian leaders headed pioneering efforts to develop aviation technology and uses. In different periods, the United States lagged behind other nations and needed highly dedicated and costly efforts to catch up.” (1998).

BOEM’s information management system is focused primarily on data relating to shipwreck and prehistoric sites on the Outer Continental Shelf (OCS). A comprehensive overview of submerged aircraft would provide documentation, historical context, and loss data that could be integrated into new aircraft databases designed for each BOEM region. This will assist with the preservation planning for historic aircraft located within Federal OCS waters.

### **Objectives:**

The study’s objective is to create a nation-wide, historical, and spatial assessment of sunken aircraft along the OCS that will assist with BOEM’s space-use development planning and historic preservation mandates under NHPA and NEPA.

**Methods:** Historical research will be conducted to develop a comprehensive list of aircraft lost over United States OCS since their inception. Existing databases will be compiled and combined to provide BOEM with information concerning histories and locations of potential wreck sites located within regional planning areas (some suggested existing databases referenced below). The study will conduct research into

the potential locations of such aircraft and describe diagnostic or unique identifiers that will aid in the identification of such craft if located during BOEM's OCS program related infrastructure related survey, maintenance, or operations. This information will be specifically designed to integrate with existing region-specific planning tools and enhance BOEM's ability to detect and manage these resources.

**Potential Database Resources:**

Airforce Legacy Program

Army Center of Military History

Aviation Archaeological Investigation and Research

Defense POW/MIA Accounting Agency

Department of Defense Legacy Resources Management Program

Heritage Preservation Services Program

National Air and Space Museum

National Parks Service

National Register of Historic Places

Naval Historical Center

U.S. Coast Guard Museum

**References:**

National Park Service (NPS), U.S. Department of the Interior

1998 *National Register Bulletin 43: Guidelines for Evaluating and Documenting Historic Properties*. Ed. Anne Milbrooke. U.S. Government Printing Office, Washington D.C.

**Revised Date:** March 30, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** National

**Administered By:** Headquarters

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

**BOEM Information Need(s) 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 2017–2019

### **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 transreceivers 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 U.S. 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 AUVs, 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:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

Study Area(s): North Atlantic

Administered By: Office of Renewable Energy Programs

Title: Using Nanotags to Measure Shorebird and Bat Responses to Offshore Wind Turbines

**BOEM Information Need(s) to be Addressed:** Tracking the movements of birds and bats at an existing wind energy facility is essential for understanding the potential risks associated 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.

**Approx. Cost:** (in thousands) \$300      **Period of Performance:** FY 2017–2018

### **Description:**

**Background:** In anticipation of offshore wind energy development on the Atlantic Outer Continental Shelf (OCS), BOEM and USFWS are collaborating on three studies that use digital VHF telemetry (“Nanotags”): 1) “Tracking Movements of Endangered Roseate Terns and Threatened Piping Plovers in the NW Atlantic”; 2) Tracking Northern Long-Eared Bat Offshore Foraging and Migration Activities; and 3) Tracking Movements of Threatened Migratory rufa Red Knots in U.S. Atlantic Outer Continental Shelf Waters. Although these studies are telling us when and where individuals are likely to travel in a wind energy area or leased area, they do not tell us how individuals may respond to the actual presence of operating wind energy turbines.

The installation of offshore wind turbines off Block Island provide a unique opportunity to understand how tagged birds and bats respond to operating turbines. The turbines will be installed within the study of ongoing BOEM nanotag studies (from several automated radio telemetry stations sited on Block Island and possibly on the turbine towers themselves). In addition to tracking tagged birds from ongoing BOEM studies, the installation of automated receivers on Block Island will be in position to track several other species of migratory birds and bats fitted with nanotags from the dozens of other ongoing projects (<http://motus-wts.org/>).

**Objectives:** Assess the response of migratory birds and bats to operating offshore wind turbines.

**Methods:** This will most likely be a cooperative agreement with the state of Rhode Island, and there will be extensive coordination with other efforts in the region.

Four automated receiver towers stations will be installed on Block Island and/or offshore wind turbine towers. Additional towers may be sited on the mainland. These automated receivers will be located so that signals from a tagged bird or bat (from existing studies) 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 movement patterns of tracked birds under a variety of offshore wind turbine operating conditions including during poor weather conditions that may compromise visibility and thus increasing the risk to birds.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** North, Mid, and South Atlantic Planning Areas

**Administered By:** Office of Renewable Energy Programs

**Title:** Fish Auditory Thresholds – Part 1

**BOEM Information Need(s) to be Addressed:** This study will help address questions regarding the impact of noise to commercially important fish such as black sea bass and squid, found in BOEM offshore renewable energy lease areas all along the Atlantic coast north of Cape Canaveral. BOEM has an obligation to understand how activities that it authorizes may impact commercially and recreationally important fish. In addition to BOEM's regulations under the Outer Continental Shelf Lands Act as amended by the Energy Policy Act of 2005, the information from this study will help in BOEM's environmental assessments under the national Environmental Policy Act and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

**Approx. Cost:** (in thousands) \$1,000      **Period of Performance:** FY 2017–2019

### **Description:**

Background: Auditory thresholds for some commercial fish species have been established while for some species such as black sea bass data is lacking. Black sea bass in particular support valuable commercial fisheries in the North, Mid, and South Atlantic Planning Areas. Black sea bass show affinity for certain habitats within the lease areas and are thus not a temporary resident of the lease areas. In addition, black sea bass produce sounds, such as grunts and thumps, which have been associated with feeding and escape. Commercial and recreational fishermen have expressed concern that noise produced during sub-bottom surveys, pile-driving, and operation of renewable energy facilities may have a negative effect on the behavior of black sea bass ranging from catchability to long-term sub-lethal behavioral impacts. This species is known to utilize mid-frequency acoustics to communicate during spawning and feeding but their sensitivities to anthropogenic sounds, and their behavioral responses to them, is not understood. Acute and chronic sub-lethal sounds may be generated as a result of offshore wind development. Black sea bass could be vulnerable because they are known to use acoustic communication and because their habitats overlap within renewable energy lease areas. If feasible, other priority species, such as squid, identified in the Normandeau 2012 (BOEM Contract # M11PC00031) may be evaluated. This study is divided into two parts. Part one is a laboratory study and part two is a field study. These will be funded under two separate awards.

Objectives: The objective of this study is to understand black sea bass, and potentially other species, behavioral and physiological effects when exposed to anthropogenic sounds.

**Methods:** The methodology would be controlled exposure studies to evaluate behavioral and physiological effects in a laboratory setting experimentation evaluating behavior and habitat use during sound exposure.

**References:**

Normandeau Associates, Inc. 2012. Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities. A Workshop Report for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M11PC00031. 72 pp. plus Appendices.

**Revised Date:** March 30, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** North Atlantic Planning Area

**Administered By:** Office of Renewable Energy Programs

**Title:** Southern New England Lobster Seasonal Movement

**BOEM Information Need(s) to be Addressed:** BOEM has an obligation to ensure that projects that is authorizes do not have a long term impact on natural resources. Although there has been several studies evaluating the effect of electro-magnetic fields (EMF) on lobster that show little to no measurable effect from EMF, there still remains concerns that entire projects may have a negative effect on lobster populations. This study would build off previous baseline study of lobster abundance in Southern New England Lease areas to better understand lobster migration of the offshore component of the species. This project would utilize commercial lobster fishermen to conduct the tagging study. This study is part of our overall science strategy for understanding baseline conditions for important commercial fishing resources in BOEM lease areas. The information collected will inform BOEM’s assessments in regards to the National Environmental Policy Act and the Essential Fish Habitat Provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

**Approx. Cost:** (in thousands) \$400

**Period of Performance:** FY 2017–2018

### **Description:**

Background: This project would build off of the knowledge gained from two years of ventless trap surveys in Southern New England offshore waters funded by BOEM. Where previous studies looked only at lobster abundance, this project would strive to understand lobster migration through a cooperative tagging program between academia, resource managers, and commercial fishermen. The information collected is important to establish pre-construction baseline lobster movements including directionality and seasonality so that potential impacts post-construction may be understood within the appropriate context. This project will also add an important third year of data to the project.

Objectives: This study will continue to document lobster abundance in Southern New England (SNE) Lease Areas and learn more about lobster habitat seasonal use patterns and migratory pathways. This information will also answer questions regarding survival rates and estimated population size of the SNE lobster population.

Methods: This study would use a combination of ventless trap surveys and tagging of individual lobsters using permitted offshore lobstermen. The ventless trap survey design is important to understand age classes that are located offshore and to ensure that results are comparable with inshore work conducted by the states and the National Marine Fisheries Service. There would need to be an intense campaign to educate commercial fishermen about the tagging study to help ensure a high rate of tag returns.

**Revised Date:** March 30, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** North Atlantic

**Administered By:** Office of Renewable Energy Programs

**Title:** Understanding the potential for seabird displacement by offshore wind energy development

**BOEM Information Need(s) to be Addressed:** Understanding how seabirds respond to the presence of an offshore wind energy facility is essential for analyzing the potential risks associated with renewable energy development along the Atlantic Coast, for NEPA assessments, and for Section 7 Consultations with the U.S. Fish and Wildlife Service.

**Approx. Cost:** (in thousands) \$480

**Period of Performance:** FY 2017–2020

### **Description:**

Background: Given the concerns of seabird mortality due to collisions with wind turbines and seabird displacement from foraging habitat, areas with relatively high concentrations of seabirds are avoided for offshore wind development. Observations of sea ducks at a large-scale offshore commercial wind facility in Europe (Petersen *et al.*, 2006) support this approach. However, it is not clear whether such an approach is appropriate for small-scale demonstration wind energy projects comprised of a handful of wind turbines. The installation of five offshore wind turbines off Block Island provide a unique opportunity to understand the scale that displacement could occur and whether it is measurable and biological meaningful for small-scale wind energy projects.

Objectives: Conduct post-construction seabird surveys to understand the potential for seabird displacement by an offshore wind energy demonstration project.

Methods: This will most likely be a cooperative agreement with the State of Rhode Island, and there will be extensive coordination with other effects in the region, including BOEM, USFWS, and developers.

Conduct aerial surveys for seabirds monthly from October to April for three year along the same transects used for Rhode Island Ocean Special Area Management Plan (SAMP) studies. Quantify the spatial distribution and abundance of seabirds. Test for displacement of select seabirds using pre and post-construction survey data. Use simulation models and data form this effort and others to understand the spatial scale at which displacement could be detected for different species and densities of birds.

**Revised Date:** January 19, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Office of Renewable Energy Programs

**Title:** Algorithm development to optimize localization accuracy of towed passive acoustic monitoring arrays used during offshore renewable energy activities

**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 and apply appropriate mitigation for the protection of marine mammals. Passive Acoustic Monitoring (PAM) has become a widely-used mitigation in order to detect marine mammal species and ensure they remain outside of protective exclusion zones during the use of active sound sources, in order to prevent injury to these protected species. To date there are no data readily available that assess the localization accuracy of towed PAM array configurations. BOEM therefore has no way of determining how effective the localizing abilities of the arrays proposed by developers for mitigation purposes are for the various types of calls produced by the marine mammal species that occur in the Atlantic. Determining effective mitigations that balance protection of marine mammals with the development of offshore renewable energy requires an understanding of the localizing accuracy of towed PAM arrays.

**Approx. Cost:** (in thousands) \$150

**Period of Performance:** FY 2017–2018

### **Description:**

**Background:** PAM is a growing technology that is already used world-wide to detect vocalizing marine mammals in order to mitigate for potential acoustic impacts to these protected species. Since PAM is not affected by visibility constraints, this mitigation technique can be used at night and in bad weather when visual observations are not possible. Developers in the renewable energy industry have requested and have been approved to conduct 24-hour high resolution geophysical surveys. Twenty-four hour operations are important to the industry considering the tremendous mobilization and operational costs associated with these surveys. Towed PAM is one of the mitigations proposed to be used during night time operations to not only detect vocalizing marine mammals, but to help ensure that animals remain outside of the exclusion zone. In order to do this the towed PAM array must be able to localize on the position of the marine mammal in order to determine the distance that the marine mammal is from the sound source. This would enable the PAM operator to determine the proper mitigation action required, for example, to shut down the sound source or not. Currently there is no readily available data that assess the accuracy of the localization abilities of towed PAM arrays. The Joint Industry Programme on exploration & production (E&P) Sound and Marine Life recently put out a request for proposals that will investigate and develop improvements for the application of towed PAM for real-time monitoring of marine mammals at sea

[http://soundandmarinelife.org/media/62487/jip22\\_phiii\\_rfpii-15-](http://soundandmarinelife.org/media/62487/jip22_phiii_rfpii-15-)

[04\\_towedpamimprovements\\_vfrev\\_26\\_11\\_2015.pdf](#)). However, this request has specific application to the towed PAM arrays used in the oil and gas industry, which are significantly different to the towed PAM arrays used to support offshore renewable energy and marine minerals activities. In addition, this study complements BSEE's current efforts to develop ANSI standards for towed PAM systems for marine mammals (<https://scripps.ucsd.edu/labs/athode/american-national-standard-on-towed-passive-acoustic-monitoring-and-mitigation-systems/>) for use throughout BOEM's programs.

**Objectives:** The first objective of this study is to examine and understand the critical parameters for designing a towed PAM array. The second objective is to develop an algorithm and identify the metrics (for example, frequency content, system configuration, system deployment configuration, trade-offs *i.e.*, localization accuracy vs. area covered for a limited number of sensors) which will affect optimization of the localization abilities of various towed PAM array designs for various protected marine mammal species.

**Methods:** Establish and verify an algorithm which specifies the physical parameters of a towed PAM array (for example, array length, hydrophone spacing, number of hydrophones *etc.*) that will facilitate the optimization and selection of an appropriate towed PAM array configuration for marine mammal mitigation purposes. The algorithm should incorporate the characteristics of multiple marine mammal species vocalizations, including, but not limited to, frequency, source level, repetition rate and directionality, as well as array operational parameters including, but not limited to, tow depth, speed, and water depth.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Office of Renewable Energy Programs

**Title:** Risk Analysis for Vessel Strikes on Whales from Offshore Wind Development Support Activities

**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 and apply appropriate mitigation for the protection of marine mammals. Vessel strikes are one potential impact that must be addressed. Determining the best mitigation that balances protection of marine mammals with development of offshore renewable energy requires an understanding of the probability of a vessel strike in the context of all activities occurring.

**Approx. Cost:** (in thousands) \$200

**Period of Performance:** FY 2017–2018

### **Description:**

**Background:** The approval of wind projects both on land and at sea typically involves an assessment of the risk they pose to wildlife. Risk is generally considered to be a function of the probability of an event occurring and the consequence of the event, should it occur. Often, there is limited information on which to base this evaluation and the default is to err on the side of precaution. The potential presence of an individual during an activity is assumed to result in an impact. Activities that are sporadic are assumed to be continuous. With these assumptions, the perceived risk is often more conservative than actual risk. While risk models exist for some species of whales, the focus is on the risk in areas of high vessel usage such as shipping lanes. For renewable energy projects, some vessel traffic is expected during construction and even less during operation and maintenance. The estimate is on vessel trip per week or a similar order of magnitude. Thus far, models have not looked at the specific circumstances nor put into context the risk.

At present, all vessels 65 feet (19.8 m) or longer must travel at 10 knots or less in certain locations along the U.S. east coast at certain times of the year to reduce the threat of ship collisions with critically endangered North Atlantic right whales. Discussions with NOAA have led to the potential extension of this requirement to all vessels at all times for vessels servicing offshore renewable energy development. While this application of the precautionary principle may seem prudent, it was not determined based on a thorough analysis of the risk. This study will conduct the needed analysis to determine if these precautions are warranted. The risk also needs to be put into context of the overall risk from collision based on other vessels in the area. Since whales migrate, the risk should be apportioned monthly. Fully assessing the risk allows for the appropriate application of mitigations such as reduction in speed.

**Objectives:** The objective of this study is to ensure appropriate mitigation from vessel strikes is applied to offshore renewable energy development.

**Methods:** The approach will be to develop a risk assessment model to address the specific circumstances for offshore renewable energy, focusing on the wind energy areas already identified. The process is to identify the risk, assess the exposure, and then characterize the risk. For vessel strikes, the number of vessels operating, the number of whales that could be impacted, and the probability of the vessel and whale occupying the same space needs to be taken into account. The results will be put into context of other vessel activities on the Atlantic OCS. The final product will be a risk model that can be used by BOEM staff to evaluate and communicate risk to the public, a report describing the methodology, and communication materials to share the results with the public.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Maryland WEA and surrounds

**Administered By:** Office of Renewable Energy Programs

**Title:** Remote Near Real-Time Detection of Marine Mammals in the Maryland Wind Energy Area

**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 impacts to, and apply appropriate mitigation for, the protection of marine mammals. Passive Acoustic Monitoring (PAM) is a widely-used mitigation in order to detect marine mammal species; ensure they remain outside of protective exclusion zones during the use of active sound sources and thereby prevent injury to these protected species. BOEM has received comments from industry about the additional cost of PAM operators, both in contracting costs and increased vessel size requirements in order to accommodate additional personnel. In addition, BOEM has received comments from Industry requesting participation in BOEM studies. There are no mobile, remote, near real-time PAM detection systems readily available. This kind of system could remove the need for physical PAM operators on board project-related vessels and the data can be used to validate, and be validated by, archival PAM data currently being collected in the Maryland Wind Energy Area (WEA). Industry has agreed to fund and install the hydrophone and cabling equipment on their meteorological tower to be installed in the Maryland WEA and additional funds are currently being sought to cover data analysis. BOEM is currently working on how to address pre-, during and post construction monitoring. This remote system could be expanded to develop a near real-time localization system for whale calls, which has never been done before. Developing this system, with Industry, in advance of the future construction phases of offshore renewable energy projects could provide stakeholders with a cheaper, effective mitigation tool.

**Approx. Cost:** (in thousands) \$230

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** PAM is a growing technology that is already used world-wide to detect vocalizing marine mammals in order to mitigate for potential acoustic impacts to these protected species. Since PAM is not affected by visibility constraints, this mitigation technique can be used at night and in bad weather when visual observations are not possible. However, current systems require PAM operators to be physically present on the survey vessel or a separate mitigation vessel, incurring additional cost to industry. Bottom-mounted arrays are also used but are archival systems and valuable data can be lost if units are dredged or lost at sea. These losses are only detected during retrieval events, months later. There are currently no mobile, remote, near real-time passive acoustic detection systems that could be used to conduct PAM mitigations or post construction monitoring. These systems could be more cost effective and provide more consistent mitigation since units are deployed on stationary platforms (for example, a

meteorological buoy or wind turbine foundation) and data files are transferred in real-time. The transmission of the acoustic data stream from the tower provides a powerful approach allowing 1) multiple and more sophisticated detectors to be run in parallel in the laboratory, and 2) provide the livestream to team members, stakeholders and the public via a web server.

Objectives:

1. Record underwater sound from a hydrophone associated with the U.S. wind meteorological tower that can transmit data to shore;
2. Perform near real-time detections of North Atlantic right whales using an automated detection system;
3. Compare the near real-time detections with data from our existing passive acoustic monitoring array to determine how well the detector is performing.

Methods: Data will be collected and analyzed within a period of 18 months. Three commercially available High Frequency Smart Hydrophones will be mounted on the base of, and powered by, the U.S. Wind meteorological tower. These are sensitive broadband digital hydrophones capable of collecting data in real-time. Their frequency range is 10 Hz to 200 kHz making it able to detect low and high frequency vocalizations. The data will be transmitted to a shore side server and then on to a research facility. Vocalizing right whales will be identified from the acoustic recordings using a combination of automated call detection software and expert human verification. These detections will be made available through a secure web interface.

The accuracy of the near real-time detection system will be calculated by calculating the percentage of detections made by the near real-time system versus the total by the archival array within the detection range. The degree of correlation and metrics of the number of true and false positives and negatives will be determined to identify whether the detection system is being too conservative or requires stricter classification parameters. Any association between environmental conditions and other noise sources will be assessed. Finally, a comparison will be made between the detection efficiency of the system and that achieved at other locations on a different platform to determine if there are any changes that could be made in the configuration with the meteorological tower to improve acoustic detections.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** North, Mid, and South Atlantic Planning Areas

**Administered By:** Office of Renewable Energy Programs

**Title:** A dynamic risk assessment of acoustic impacts of wind farm development on North Atlantic right whales off the U.S. East Coast

**BOEM Information Need(s) to be Addressed:** The objective of this study is to apply a Dynamic Risk Assessment Model for Acoustic Disturbance which accounts for the movements of whales before, during and after noise exposure using ecological modeling. This approach is relevant to BOEM in the context of offshore renewable energy wind farm development because the risks of noise exposure to protected species during construction and operations can be assessed on a larger scale. In addition, this information could provide more accurate assessments of risk to inform the calculation of incidental take under the Marine Mammal Protection Act, as well as potentially include cumulative impacts of multiple projects along the Atlantic. All this information will assist BOEM’s environmental assessments under the National Environmental Policy Act and the Endangered Species Act.

**Approx. Cost:** (in thousands) \$450

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** The North Atlantic right whale is the most endangered large whale species on the Atlantic coast, and one of the most intensively studied populations in the world. This population faces multiple challenges including vessel strike and entanglement in fishing gear. These whales are low frequency vocalizers and although the biological effects of the construction and operation of offshore wind facilities on right whales is currently unknown, there are concerns that renewable energy activities on the Outer Continental shelf may cause masking of inter-specific vocalizations or potentially displace these whales from their inshore habitat or result in behavioral changes that may make them more likely to be hit by vessels. Current modeling efforts do not take the dynamic movement of these whales into consideration. An ecological approach, more representative of actual species movement and behavior, is needed to try to better understand the potential acoustic impacts to this endangered species. In addition to sighting data from the North Atlantic Right Whale Consortium and density and abundance maps prepared by Duke University, passive acoustic monitoring projects, previously and currently, funded by BOEM and NMFS will provide habitat use and occurrence data to inform this type of risk modeling initiative. Case studies have been performed for bowhead and beluga whales and these showed that risks from sound exposure can be reduced using a stepwise approach involving sound modeling and ecological modeling (Frank Thomsen, Partnering Forum 2015).

This study will help understand the acoustic impacts of offshore renewable energy construction and operations activities in a dynamic sense, which is a more accurate representation of the marine ecosystem compared to other static modeling efforts. A

major concern raised by the general public, non-governmental organizations, academia and resource agencies is the acoustic effects of renewable energy activities on the highly endangered North Atlantic right whale. BOEM has an obligation to understand how activities that it authorizes may impact protected species. In addition to BOEM's regulations under the Outer Continental Shelf Lands Act as amended by the Energy Policy Act of 2005, the information from this study will help in BOEM's environmental assessments under the National Environmental Policy Act and the Endangered Species Act.

**Objectives:** The objective of this study is to apply a Dynamic Risk Assessment Model for Acoustic Disturbance (DRAMAD) which accounts for the movements of whales before, during and after noise exposure using ecological modeling, including cumulative effects of existing stressors. Special focus will be given to critical habitat areas, with respect to access to, and displacement from, these areas. A second objective is to determine cumulative effects of potential renewable energy activities over the next 10 years, based on the best available data.

**Methods:** The DRAMAD tool is a combination of hydrodynamic-, habitat-, noise- and agent based modeling. Based on a detailed hydrodynamic model of the study area, dynamic habitat models correlate the sightings of the whales to environmental variables and pressures (*e.g.*, shipping, fishing) to identify areas or periods of time where suitable habitat and stressors intersect. The habitat suitability maps can be used to assess risks due to individual developments or other potential impacts. In addition, individual based models recreate the movement of the whales. They are used to assess reactions to noise on a smaller scale.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Office of Renewable Energy Programs

**Title:** Fish Auditory Thresholds – Part 2

**BOEM Information Need(s) to be Addressed:** This study will help address questions regarding the impact of noise to commercially important fish such as black sea bass and squid, found in BOEM offshore renewable energy lease areas all along the Atlantic coast north of Cape Canaveral. BOEM has an obligation to understand how activities that it authorizes may impact commercially and recreationally important fish. In addition to BOEM's regulations under the Outer Continental Shelf Lands Act as amended by the Energy Policy Act of 2005, the information from this study will help in BOEM's environmental assessments under the national Environmental Policy Act and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

**Approx. Cost:** (in thousands) \$1,000      **Period of Performance:** FY 2018–2020

### **Description:**

Background: Auditory thresholds for some commercial fish species have been established while for some species such as black sea bass data is lacking. Black sea bass in particular support valuable commercial fisheries in the North, Mid-, and South Atlantic Planning Areas. Black sea bass show affinity for certain habitats within the lease areas and are thus not a temporary resident of the lease areas. In addition, black sea bass produce sounds, such as grunts and thumps, which have been associated with feeding and escape. Commercial and recreational fishermen have expressed concern that noise produced during sub-bottom surveys, pile-driving, and operation of renewable energy facilities may have a negative effect on the behavior of black sea bass ranging from catchability to long-term sub-lethal behavioral impacts. This species is known to utilize mid-frequency acoustics to communicate during spawning and feeding but their sensitivities to anthropogenic sounds, and their behavioral responses to them, is not understood. Acute and chronic sub-lethal sounds may be generated as a result of offshore wind development. Black sea bass could be vulnerable because they are known to use acoustic communication and because their habitats overlap within renewable energy lease areas. If feasible, other priority species, such as squid, identified in the Normandeau 2012 (BOEM Contract # M11PC00031) may be evaluated. This study is divided into two parts. Part one is a laboratory study and part two is a field study. These will be funded under two separate awards.

Objectives: The objective of this study is to understand black sea bass, and potentially other species, behavioral and physiological effects when exposed to anthropogenic sounds.

Methods: The methodology would be field studies to evaluate behavioral and physiological effects evaluating behavior and habitat use during sound exposure.

**References:**

Normandeau Associates, Inc. 2012. Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities. A Workshop Report for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M11PC00031. 72 pp. plus Appendices.

**Revised Date:** March 30, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Atlantic

**Administered By:** Office of Renewable Energy Programs

**Title:** Evaluating Offshore Wind Energy’s Economic Impact to Tourism and Recreation

**BOEM Information Need(s) to be Addressed:** Understanding how tourism may be impacted by the development of offshore wind energy facilities is important to assess under BOEM’s National Environmental Policy Act responsibilities. It has been suggested that tourists and recreationalists may change their behavior in selecting destinations due to the visibility of an offshore wind energy facility. The results will be valuable for current and future leases particularly related to mitigation discussions of visual impacts (*e.g.*, minimal setbacks from shore).

**Approx. Cost:** (in thousands) \$455      **Period of Performance:** FY 2018–2020

### **Description:**

**Background:** BOEM has completed a baseline study regarding the relative importance of tourism and recreation to coastal counties along the Atlantic (ICF, 2012). Potential impacts to recreation and tourism are largely dependent on the public’s perception of wind facilities. In 2016, BOEM is funding a survey to collect data regarding public attitudes and values about offshore wind using visual simulations at varying distances from shore. Data from the survey will provide input to a Travel Cost Random Utility Maximization Model, which can estimate the relative value of beach characteristics (BOEM, 2015).

Studies from Europe indicate that public opinion becomes more positive once the offshore wind facility is operational (Cronin *et al.*, 2015). This study would advance BOEM’s understanding from predicted model behavior results to a real world application. In 2016, BOEM’s Pacific Region anticipates awarding “Recreation, Tourism, and Community Perspectives in Southern Oregon Before and After Offshore Wind Development.” Although this project can provide a comparative point, studies have shown that public attitude toward wind projects differs between locations due to culture, development of existing landscape, and economic dependence on the ocean. BOEM will use the Pacific’s study as a starting point, so as to not duplicate efforts and to ensure consistent methodology.

The purpose of this study is to create a set of hypotheses to directly test if tourist and recreationalist behavior changes during construction and operation of an offshore energy wind facility is visible from shore. Additionally improving BOEM’s understanding of how tourist-related industries adjust, such as offering boat tours to see the wind turbines, is another potential impact to recognize. Such data will be valuable to validate or challenge concerns raised by state and local governments about potential impacts to their coastal economies.

### Objectives:

- Establish a baseline of frequency of tourist and recreation activities and associated expenditures, that occur within sight of the future wind energy facility
- Measure changes in frequency of tourist and recreation activities and associated expenditures during construction of wind energy facility and after
- Determine how the tourism-related industry responds to offshore wind energy project
- Provide a framework for tourism and recreation monitoring at other locations

Methods: BOEM will determine the location of the project based on the likelihood of a visible wind project in one of BOEM's leases during the study time period and dependence of the shoreline economy on tourism.

Following established community-based research methods, researchers will collaborate with business owners, economic development leaders, and others engaged in the tourism sector to identify priority research questions and develop appropriate citizen-science tools. Adopting a community-based approach enables the potentially impacted community to be involved in the assessment and has been shown to increase the relevance and usability of the research.

Tourism does not exist as a distinct sector in any system of economic statistics so, based on input from the community, an economic analysis will be conducted of changes in tourism expenditures in specific categories, such as lodging, rental properties, and tour boat operations. The methodology will need to control for other factors (*e.g.*, regional economic health) that could change tourism levels during the study period.

Primary data will be collected to determine shifts in behavior (*e.g.*, spatial use patterns, participation in tourism-related activities, *etc.*) and expenditures during the three project phases (baseline, construction, operational). These surveys will be ground-truthed through observation to count the numbers of visitors and the numbers of participants in various activities during each project phases.

### **References:**

BOEM, 2015. Atlantic Offshore Wind Energy Development: Public Attitudes, Values, and Implications for Recreation and Tourism. Cooperative Agreement with University of Delaware.

Cronin, T., Ram, B., Gannon, J., Clausen, N-E., Thuesen, C., Maslesa, E., Geraldi, J., 2015. Public acceptance of wind farm development: Developer practices and review of scientific literature. DTU Wind Energy E; No. 0051.

ICF Inc., 2012. Atlantic Regional Wind Energy Development: Recreation and Tourism Economic Baseline Development. BOEM. OCS 2012-085.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Office of Renewable Energy Programs

**Title:** Information Transfer Meeting for Atlantic Renewable Energy Studies

**BOEM Information Need(s) to be Addressed:** Since 2008, the Environmental Studies Program has funded studies along the Atlantic in support of offshore renewable energy. With approximately 25 completed and 20 ongoing studies, BOEM has collected a broad body of information that is useful for offshore wind development. While this information is readily available on our website, an information transfer meeting would provide a venue for sharing this information with the public, especially from ongoing studies that do not have final reports.

**Approx. Cost:** (in thousands) \$250

**Period of Performance:** FY 2018

### **Description:**

**Background:** In past decades, BOEM (formerly MMS), has used Information Transfer Meetings (ITMs) to share information with the public about ongoing studies and other relevant topics. These annual or biannual meetings were particularly useful as they gave the public an opportunity to hear results from studies that were not yet complete and, therefore, a final report was not available. The presentations enabled the public to learn what was planned and what was already executed in the way of field work. In some instances, initial observations were included. Along with the presentations, a summary document was prepared. The ITM Proceedings, that included brief written descriptions by the presenters of the work, were often the only sources for reference in environmental documents while the study was ongoing. The ITM also served as an opportunity for researchers to hear about other work and potentially collaborate on their work.

BOEM now has sufficient studies funded to support a one to two day meeting where the investigators can be brought together to present their results to the public. This is also an opportunity for the public to ask questions and gain clarification on the work being conducted. The topics for presentation could be expanded to include other work being conducted along the Atlantic in support of offshore renewable energy as well as investigators from other countries. While international experts would not be the focus of the meeting, BOEM would benefit from their participation.

BOEM is currently planning a Science Forum to support all three programs, oil and gas, renewable energy, and marine minerals to be held in South Carolina. The forum will include invited experts to share their knowledge with BOEM staff as well as the public over two days. While it is important to share this knowledge in the Southeast, most Renewable Energy projects are focused from Massachusetts to Virginia and this ITM would be held in Rhode Island, New Jersey, Maryland, or Virginia.

**Objectives:** Provide the public with the most recent status and results of studies that are ongoing or recently completed in support of offshore renewable energy development along the Atlantic coast.

**Methods:** BOEM would host a one to two day meeting for the public where results of ongoing studies as well as recently completed studies would be presented. At least two tracks would be offered including distribution of wildlife and human activities. Presentations could be expanded to include DOE-funded studies and other relevant scientific endeavors along the Atlantic in support of offshore renewable energy.

**Revised Date:** March 30, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** North and Mid-Atlantic

**Administered By:** Office of Renewable Energy Programs

**Title:** Tracking Movements of a Suite of Priority Shorebirds Off the U.S. Coast to Better Understand Movements in Adverse Weather & Darkness

**BOEM Information Need(s) to be Addressed:** This study would provide new information on movements and flight altitudes of focal shorebird species identified in the Outer Continental Shelf (OCS) region during migratory periods. This information will allow scientists to assess the degree to which focal shorebird species use offshore Federal waters during migration, and better understand how migratory movements are effected by adverse weather conditions and time of day. This information is essential for understanding the potential for these species to encounter conflicts with renewable energy development in these areas, for NEPA assessments, and for consultations with the U.S. Fish and Wildlife Service. It will also permit the gathering of information on flight paths and altitude estimates of these birds during periods of inclement weather and limited visibility, when collision risks with turbines may be elevated.

**Approx. Cost:** (in thousands) \$1,700      **Period of Performance:** FY 2018–2020

### **Description:**

**Background:** Since FY 2013, BOEM and USFWS have been collaborating on a project that has verified the effectiveness of using digital VHF telemetry (“Nanotags”) and automated radio telemetry stations to track movements of coastal birds, including American Oystercatchers (*Haematopus palliatus*), Common Terns (*Sterna hirundo*), Federally-endangered Roseate Terns (*Sterna dougalli*), and Federally-threatened Piping Plovers (*Charadrius melodus*) in coastal and Federal ( $\geq 3$  nm) waters.

For these studies, the movements of tagged birds have been tracked using an array of eight (2013) to 20 (2015) automated radio telemetry stations, distributed from Cape Cod, MA, to eastern Long Island Sound, NY. To date, millions of detections of tagged terns and shorebirds have been recorded as they move throughout the southern New England shelf during their breeding, post-breeding and migratory periods (June to September). Design and placement of radio telemetry towers have been optimized for offshore detection range; terns can be tracked to distances of up to 20 km, and shorebirds to distances of up to 80 km. Nanotag technology has proven effective for tracking the offshore movements of birds across regional scales, around-the-clock and during all weather conditions. In 2016, work with terns and plovers will continue. Additionally, a new study is being initiated to understand movements of Red Knots, which will establish ten new automated radio telemetry stations in the mid-Atlantic region.

The work proposed here aims to collect additional information on the movements of additional focal shorebird species that use the coast during migration, and to expand the

radio telemetry array to include twenty additional sites configured to monitor movements near major migratory stopover areas in New England and the U.S. mid-Atlantic and Gulf of Mexico. We will work with USFWS Division of Refuges in Regions 4 and 5, state agencies within those region, and NGOs (*e.g.*, Manomet, The Nature Conservancy) to site and operate telemetry towers in areas identified as high priority staging and stopover areas.

In addition, this study proposes to employ new techniques (*e.g.*, GSM-GPS tags and/or altimeters/ temperature sensors) in combination with nanotags to estimate altitude of tagged birds in flight. This information is essential for determining the extent to which birds passing through wind energy areas are flying within the rotor-swept zone, and thus may be at risk of collision with wind turbines.

**Objectives:** The objective of the study is to document movements of focal shorebird species along the OCS to determine the occurrence, extent, and altitudes of their flights over Federal waters, particularly during inclement weather and night. This information will better identify potential conflicts to inform ideal placement of alternative energy development projects.

**Methods:** Each year, during fall migration, a total of 100 shorebirds of 4-6 focal species representing a cross-section of (*e.g.*, Semipalmated Sandpiper, Ruddy Turnstone, Sanderling, and Whimbrel) will be captured at stopover areas within Canada and Massachusetts, in collaboration with partners from Environment Canada and the USFWS Refuge System. Small-bodied shorebirds will be tagged using Nanotags. Signals from Nanotags will be picked up from automated receiver towers stationed from Cape Cod, MA to North Carolina and in Gulf of Mexico. These receivers will be located so that signals can be received simultaneously from a minimum of two towers, allowing '2-dimensional' locations to be obtained. In instances where signals are detected from a minimum of four towers, more precise '3-dimensional' locations of birds will be estimated. We propose to model movement pathways using models currently being developed at the University of Massachusetts, and determine to calibrate altitude using signal strength. Larger-bodied shorebirds such as Whimbrel may be tracked with a new 15g solar powered GSM-GPS tag currently in development, which provides locations within 3m accuracy and determines altitude. These tags log up to 100,000 locations, and then upload them to a database each time the tag is within range of a cellular tower. Solar-powered GSM-GPS tags can provide locations every 1–2 hours, and are anticipated to last for 2–3 years.

Movement data will be used to estimate movement patterns in offshore waters relative to weather conditions (*e.g.*, wind speed, wind direction, barometric pressure, visibility, precipitation) and time of day (darkness vs. daylight).

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area:** Gulf of Mexico OCS

**Administered By:** Headquarters/Gulf Region, Marine Minerals Program

**Title:** Ecological Function and Recovery of Biological Communities within Sand Shoal Habitats within the Gulf of Mexico

**BOEM Information Need(s) to be Addressed:** This study proposes a new collaborative effort to investigate the long-term recovery of benthic and fish communities following dredging following dredging sand resources within Ship Shoal in the Gulf of Mexico. BOEM needs to observe prolonged biological, physical and chemical recovery of borrow areas located within Ship Shoal to understand the importance of dredged habitats to benthos, fish, and trophic structure/bioenergetics. Existing project-specific, post-construction monitoring is not of sufficient duration or temporal resolution to fully understand these sand complexes. In the absence of extended and temporally-resolved monitoring data, short-term perturbations cannot be differentiated from natural disturbances and seasonal changes, or longer-term trends, such as climatic oscillations. Observations over an extended time frame will allow for BOEM to identify the potential impacts of multiple sediment removal activities at Ship Shoal and determine the extent, nature, and process of disturbance and recovery. Initial data from an on-going project of this type off Florida has led to some valuable information. This information on recovery is necessary for improved regional management of offshore habitat availability for prey and fish species. This knowledge will improve effects analyses in National Environmental Policy Act (NEPA) documents and greatly focus and improve the outcomes of EFH consultations.

**Approx. Cost: (in thousands) \$2,850 Period of Performance:** FY 2017–2019

### **Description:**

**Background:** The MMP is often involved with coastal restoration and construction projects that follow severe storms and accidental events such as Hurricane Katrina. Environmental monitoring may be a requirement for project proponents to access and use sand resources. However, because of the relative expense, monitoring is generally limited in scope and concluded within a year of project completion. Previous studies have indicated that the recovery time may be greater than 3 years particularly in borrow areas that are repetitively used, such as Ship Shoal (Byrnes, *et al.* 1999). In one of only two previous long term (5–10 years) studies, species composition in the borrow area still differed after 5 years (Turbeville and Marsh 1982). The benthic communities may exhibit biomass recovery within 3 months to 2.5 years; however their taxonomic composition can remain different for more than 3-5 years (Michel, *et al.* 2013). In the Fall of 2013, the MMP initiated a comprehensive borrow area recovery study on Canaveral Shoals, Florida (currently funded until Fall 2019). Since study initiation we have had some novel findings. For example, there are fewer residential fishes on cape-associated shoals than previous thought (*i.e.*, spot and croaker). This information is extremely important when discussing the disturbance of a shoal and analysis of

residential versus transient communities. This information is also critical for habitats dredged in regions such as the Gulf of Mexico. The duplication of the Canaveral Shoals study at Ship Shoal will expand our understanding of the recovery of sand shoals in different physical and biological environments.

**Objectives:** The objectives of this study are to examine the relationship of human disturbance to ecosystem services in offshore sand shoal habitats. Further, to determine if there are functional differences in borrow sites pre- and post-dredging by examining species distribution, diversity, habitat use, and population dynamics.

Questions BOEM would like to address include:

1. Are there functional differences between the borrow sites and control sites?
2. If so, do these differences correlate with biophysical differences (grain size, flow characteristics)?
3. What is the rate of recovery of benthic habitats and habitat use in a previously dredged borrow site on the OCS (to be examined through subsequent phases over a 7–10 year period)? And is this rate of recovery tied to any physical factors?
4. Do the reestablished sites fill the same trophic function as the original communities?
5. Are there regional differences in recovery (Gulf of Mexico vs. Atlantic) and, if so, what is driving these differences?

**Methods:** The proposed study sites include the Ship Shoal borrow area and nearby control sites off Louisiana. Pre-disturbance and post-disturbance physical and biological sampling will occur following a Before-After-Control-Impact (BACI) methodology. The methodological approach will match, as closely as possible, the sampling and analytical methods used in the ongoing Canaveral Shoals study for a three year period with consideration for longer term monitoring. There is also a proposed study to monitor the physical recovery and water quality at Ship Shoal borrow areas. BOEM has recently funded a new met-ocean permanent observation station in the vicinity of Ship Shoal that will provide important observations. A suite of data from previous monitoring is available including bathymetry, geological and geophysical data, fish and benthic assemblage data. Additional sampling regimes will include multibeam sonar, Acoustic Doppler Current Profiler (ADCP) wave/current measurements, sediment cores, benthic grabs, benthic community analysis, trawls, acoustic telemetry, seasonal and diel observations, gut content analysis, stable isotope analysis, *etc.* Data will be collected from different habitat settings at each site (side of shoal, shoal crest, shoal slipface, and offshore sites seaward and landward of the shoal sand body over multiple seasons during the day and night following a random stratified methodology. These data are will provide a critical baseline for future long-term efforts examining the resiliency of these habitats. Observations will be analyzed via basic statistical procedures (*e.g.*, determination of mean values, standard deviations, transformations of data, and comparisons of means) along with more complex statistical analyses and comparisons of community structure. These observations will also be integrated into an *Ecosim* model to assess the perturbation to the system.

**References:**

Byrnes, M. R., et al. Environmental Survey of Identified Sand Resource Areas Offshore Alabama: vol.I: Main Text, Vol.II: Appendices. OCS Report MMS 99-0052, U.S. Department of Interior Minerals Management Service, 1999.

Michel, J., A. C. Bejarano, C. H. Peterson, and C. Voss. Review of Biological and Biophysical Impacts from Dredging and Handling of Offshore Sand. OCS Report BOEM 2013-0119, Herndon, VA.: U.S. Department of Interior, Bureau of Ocean Energy Management, 2013.

Turbeville, D. B., and G. A. Marsh. Benthic Fauna of an Offshore Borrow Area in Broward County, Florida. . Miscellaneous Report No. 82-1, U.S. Army Corps of Engineers Coastal Engineering Research Center, 1982.

**Revised Date:** March 21, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Headquarters, Marine Minerals Program

**Administered By:** Atlantic OCS

**Title:** Assessing Biological and Oceanographic Processes that Drive Fisheries Productivity on New England Sand Shoals and the Potential for Dredging Related Disruption

**BOEM Information Need(s) to be Addressed:** BOEM’s Atlantic Sand Assessment Project identified potential OCS sand resources that could be used for future coastal resiliency needs. The use of offshore sand resources to support coastal resiliency efforts in the Northeast region have historically been constrained due to uncertainty surrounding the potential implications to high valued fisheries. Investing in baseline biological and oceanographic data to parameterize fishery productivity in sand shoals and their resilience to potential physical disturbance will improve BOEM’s capabilities relative to the MMP following our initial sand resource evaluation investments. The results of this study would better inform the current perceptions regarding dredging impacts to commercial fisheries by understanding the processes of productivity in sand shoal areas and the associated risks to fisheries landings. In addition, an understanding of these processes and their spatial/temporal annual fluctuations provides the opportunity to identify low impact environmental windows during which resource extraction could have reduced fishery impact. The results of this study will be utilized in NEPA analyses and associated consultations. In addition, this study further supports Regional Ocean planning by “identifying best dredging practices, and ways to minimize impacts” as well as working “to better engage the fishing industry through specific mechanisms and improved data.” (Draft New England Region Ocean Action Plan)

**Approx. Cost:** (in thousands) \$1,300 **Period of Performance:** FY 2017–2019

### **Description:**

**Background:** While we know that offshore sand features are habitat for forage fish, we do not know the impacts that may occur to the forage fish from altering this habitat. In the Northeast United States, there are several key forage species including, sand lance, *Ammodytes* spp.; longfin squid, *Loligo* spp.; and herring-like fishes, *Clupeidae*; that occur over potential sand borrow areas. This study would identify forage fish that occur in potential borrow areas. Many forage fish have demersal eggs and dredging can disrupt egg masses, suspending and transporting them out of the system, negatively impacting fisheries production. This aspect of the prey cycle needs to be better understood prior to effective modeling of potential fishery impacts. The degree to which forage fish populations are internally-supported (self-recruiting), within the sand shoal, or externally driven (reliant on spawning from outside group), *e.g.*, a source or sink is currently unknown. This knowledge gap is an impediment to our current ability to understand potential fishery impacts of dredging in the Northeast.

Trophic connections and recovery rates among species dependent or influenced by sand habitat productivity are not understood. There are a whole suite of questions to be answered including: is productivity locally driven, is it based on outside or internal recruitment, does disruption lead to a shift in prey species and, if so, are there impacts from that shift? Combining life history data obtainable through otolith analysis with hydrodynamic models affords the tracing of larval sand lance movement addressing problems of population sources and sinks. Such information is vital to assessing the importance and resilience to commercial fisheries of borrow areas as well as the spatial scale and temporal opportunities at which dredging should be considered.

This study focuses on the collection and analysis of biological and oceanographic data that might indicate the drivers for forage fish distribution and abundance on sand shoals. In addition, this study will examine potential changes in these parameters following borrow area use and how these changes could impact commercial fishes and fisheries. These data will be used to inform decision-scenario models to predict the potential for disturbance to impact commercial fisheries. Finally, this study will ask whether or not there are low impact windows of opportunity that might exist.

**Objectives:** Leverage existing spatial, fisheries, oceanographic data and model frameworks to evaluate the potential environmental and economic impacts to sand dredging in New England by: a) Quantifying habitat use patterns of commercial and ecologically important fisheries, including key prey species and the system dynamics that explain inter-annual variation. b) Within known habitat, identifying driving factors for abundance (biomass) fluctuations of these key prey species. c) Understand larval dispersal patterns and life-stages in sand borrow areas for forage species to identify optimal dredge windows. d) Combine existing long-term fisheries data with life history results of this study (*i.e.*, spatial/temporal variation in prey species dynamics) into a framework to predict impacts to fisheries resulting from various dredge scenarios.

**Methods:** Methods would include incorporating comprehensive benthic sampling data that has been completed by USGS, University of Massachusetts Dartmouth, NMFS, and others; completing finer scale benthic grabs to ground truth sampling; Seabed Observation and Sampling System (SEABOSS) sediment grabs for live forage fishes and collection of water quality data; otolith microstructure analysis; employing a dynamic model, such as MIMES or *Ecosim*. Additional methods employed will utilize existing methodology for quantifying prey density through visual and acoustic survey. The source/sink investigations will also take advantage of the cooperative agreement between BOEM and the University of Massachusetts at Dartmouth that is evaluating regional currents. The results could be applied to determine how disturbance and physical oceanography alter larval dispersion.

**Revised Date:** March 21, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Headquarters/Gulf Region, Marine Minerals Program

**Administered By:** Atlantic and Gulf of Mexico OCS

**Title:** BioGliders: Leveraging Marine Animals as Mobile Telemetry Sensor Networks

**BOEM Information Need(s) to be Addressed:** This study implements BOEM's Outer Continental Shelf Lands Act mandate to assess and manage 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, yet expansive sensor networks can be cost prohibitive. 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, dredging, platform construction and demolition. Animal telemetry can provide relevant information for NEPA, MMPA, ESA consultations across program areas such as dredging, wind and hydrokinetic siting, 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. Results of this effort would be applicable to the Marine Minerals Program (MMP) as well as the Office of Renewable Energy Programs.

**Approx. Cost: (in thousands) \$495 Period of Performance: FY 2017–2019**

### **Description:**

**Background:** Tracking of highly mobile marine megafauna is typically accomplished by Argos satellite however to understand fine scale movements within a particular habitat, acoustic telemetry is often employed. This presents a significant challenge to understanding movements on multiple scales due to the fixed locations of acoustic telemetry receivers and lack of finer scale behavioral data within the array. Acoustic telemetry affords considerable cost savings when compared to satellite and affords multi-scale movement analysis through network collaborations. Acoustic tags work by having an active 'ping' which is then received and logged by a receiver. Anchored receivers globally are logging movements of fishes from small salmon smolt to whale sharks. The stationary nature of receiver arrays mean that if an animal does not pass through the array, you're unable to gather data. Arrays can be extended mechanically by outfitting transceivers, devices that both transmit to other receivers and receive from tagged fish, to electronic, thermal, or wave powered gliders. However, operating gliders to extend acoustic receiver arrays is cost intensive and does not shed information on inter-species behavior which can be impacted by BOEM activities. BOEM is currently purchasing a glider for our Canaveral Shoals study (NT-16-08 Natural Habitat Associations and the Effects of Dredging on Fish at the Canaveral Shoals, East, Florida), however, leveraging mobile animals as mobile observation networks can further improve coverage and make for a more cost effective solution to supplemental

monitoring. Extending sensor arrays using large mobile megafauna such as Manta and Whale Sharks, enables observation of ecological interactions while understanding movements of tagged animals. (IOOS Animal Telemetry Network, 2015; Pittman, 2014).

Currently, several BOEM supported studies leverage acoustic telemetry, most notably, the aforementioned partnership between BOEM, NASA and the Navy off Cape Canaveral, FL. This partnership, developing and managing the acoustic array and glider, is a compliment to the long term ecosystem monitoring study by the University of Florida (UF) “Ecological Function and Recovery of Biological Communities within Dredged Ridge-Swale Habitats in the South-Atlantic Bight” in which BOEM has invested over \$5 million in funds. The study proposed here is designed to complement existing project infrastructure (*i.e.*, acoustic arrays, existing tagged fish, developed eco-path/sim models, *etc.*), and established partnerships (U.S. Navy, NASA, BOEM, UF) make it well suited to support long term analysis of ecosystem 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. Additional capacity of mobile transreceiving units, will expand our understanding of the restoration of this habitat while simultaneously allowing further description of habitat use by these protected species.

**Objectives:** 1) Test the use of marine megafauna, such as Manta and Whale Sharks as platforms for collecting data as mobile transreceivers, effectively expanding telemetry sensor networks beyond stationary arrays or expensive oceanographic gliders. 2) Describe habitat use of filter feeding pelagic megafauna in the vicinity of Canaveral Shoals 3) Engage coastal stakeholders in BOEM science through educational programming based on spatial telemetry.

**Methods:** Tagging will commence where Manta and Whale Sharks typically aggregate in large numbers off the Central Florida coast, Mexico’s Yucatan Peninsula, the east coast of Florida, and Ewing Bank in the Northern Gulf of Mexico. Specialized tags (*viz.* VEMCO Mobile Transceiver [VMT]) can allow for the detection of 69 kHz acoustic transmitters on BOEM’s existing Canaveral Shoals receiver array as well as behave as a transmitter affording detection to be registered on receiver arrays. An Argos satellite linked transmitter and VHF transmitter allow for proximity data to be transmitted remotely, and, if feasible, enable rapid recovery of linked tags to afford downloading fine scale data in a similar manner as current acoustic receiver arrays.

## **References**

Pittman SJ, Monaco ME, Friedlander AM, Legare B, Nemeth RS, Kendall MS, *et al.*, (2014) Fish with Chips: Tracking Reef Fish Movements to Evaluate Size and Connectivity of Caribbean Marine Protected Areas. PLoS ONE 9(5): e96028. doi:10.1371/journal.pone.0096028

**Revised Date:** March 21, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Alaska OCS Region

**Title:** Generation of Synthetic Audiograms by Applying Finite Element Modeling to CT Scans for Marine Mammals

**BOEM Information Need(s) to be Addressed:** BOEM requires information on the effect of anthropogenic ocean noise on marine mammal behaviors and demographics to evaluate potential environmental impacts from oil and gas activities and identify mitigation measures under NEPA. Regulatory agencies also need such information in their decision-making processes when issuing incidental take regulations under the Marine Mammal Protection Act (MMPA) and making a final determination of the status of marine mammals under the Endangered Species Act (ESA). As the arctic ice pack continues to diminish, the potential for increased vessel and anthropogenic activities remains high, and with it the potential for effects of noise associated with these activities becomes increasingly important. Results from this study have the potential to provide a more direct quantitative basis for estimating the numbers of potentially affected marine mammals.

**Approx. Cost:** (in thousands) \$2,000      **Period of Performance:** FY 2017–2021

### **Description:**

**Background:** Indirect methods are often used to describe marine mammal sound reception mechanisms and estimate the potential effects of anthropogenic sound. We indirectly infer that these animals can hear the sounds they produce, or we deduce hearing characteristics from the morphology of the ears, or we attempt to untangle complex behavioral reactions to specific sounds. Recent work by Cranford and Krysl (2015) illustrate a mechanism to generate synthetic audiograms for an animal by applying finite element modeling tools to X-ray computed tomography (CT) scans. The study proposed here focuses on this unique approach – generating synthetic audiograms for marine mammals by applying finite element modeling tools to CT scans of the heads of postmortem specimens made available through strandings or subsistence activities.

The hearing mechanisms for marine mammals are different because some are dominated by bone conduction, while others rely primarily on pressure loading through soft tissues. These differences can be illuminated by using Finite Element Models to predict audiograms and describe the directional characteristics of the sound reception apparatus. Instead of assuming that an animal is exposed to a sound when it is in the calculated zone of influence of the sound, as is currently done, a map of auditory sensitivity from various angles can be calculated to gain a better understanding of potential exposure levels from incoming sound. This approach will not only provide much needed audiograms for multiple species of marine mammals for which a head with the associated auditory features are present, but it will also allow calculation of the pathways through which a marine mammal can be exposed to a sound. In doing so,

estimation of the number of incidental takes during anthropogenic activities that produce sound may be more accurately accessed and monitored.

**Objectives:** The objectives of this study are to evaluate hearing sensitivity and identify sound reception mechanisms in cetaceans (*e.g.*, bowhead whale, beluga whale) and Pacific walrus, and potentially other marine mammals as available to visualize what occurs when sound interacts with the anatomy of a head.

**Methods:** The researchers and BOEM will coordinate with agencies involved in stranding and/or subsistence activities to obtain heads of marine mammals, in accordance with appropriate permits. The heads will be shipped to a CT scanner which is large enough to fit these, and will be scanned using state-of-the-art techniques. An appropriate finite element modeling toolkit will be used to simulate a vibration that is conducted through bones and/or soft tissue to the hearing apparatus. It is expected that this will differ between a Mysticete, such as a bowhead, and an Odontocete, like a beluga, based on their different morphology, as it will for the walrus and likely other marine mammals. The auditory sensitivity from various angles will also be calculated to gain a better understanding of potential exposure levels to sound coming from various angles.

This newly described technique (Cranford and Krysl; 2015), is a verified and validated computational approach; predictions with models of sound reception have been compared with experimentally determined data. These cutting edge techniques have applications for solving a national need and providing basic bioacoustic parameters for these marine mammals. These finite element models have the potential to generate audiograms that are simply not otherwise obtainable for these large, marine animals.

**References:**

Cranford, T.W. and P. Krysl. 2015. Fin Whale sound reception mechanisms: Skull vibration enables low-frequency hearing. PLoS ONE 10(1): e0116222. doi: 10.1371/journal.pone.0116222. pmid:25633412. 17 pp.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Alaska OCS Region

**Title:** Geospatial Mapping – A Geodatabase and Visualization Tool Set

**BOEM Information Need(s) to be Addressed:** Timely and efficient access to data and information products is essential for BOEM to make effective well informed policy decisions and to foster improved research and synthesis activities. Recent investments in data collection and model generation in the Arctic and Lower Cook Inlet regions have produced extremely valuable information which is multidisciplinary in nature. In order to leverage this massive investment in research, BOEM requires a data management framework that provides a platform for data discovery, visualization and synthesis, and analysis of temporal and spatial coverage. BOEM needs existing environmental studies data integrated into geospatial formats for upcoming environmental analyses for lease sales proposed for the *2017–2022 OCS Oil and Gas Leasing Program*. Results from this project will inform NEPA analysis and documentation for lease sales, exploration plans (EPs), and development and production plans (DPPs), as well as providing information and data to support drafting of new studies descriptions and creating presentations for meetings.

**Approx. Cost:** (in thousands) \$200

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** Data produced from BOEM-funded activities are complex, can be packaged and stored in a variety of advanced formats, and describe a wide spectrum of scientific observations and metrics. Relevant data are produced by real-time sensors and remote sensing satellite/observational platforms, collected by researchers performing field studies or cruises, and produced from model outputs and data syntheses. Due to these complexities, digesting and fully harnessing these resources can be extremely difficult for potential users. Additionally, data will only become more voluminous and complex as models, sensors and sampling designs increase in sophistication.

BOEM NEPA analysts need data specifically adapted to BOEM's unique spatial considerations. While many BOEM-funded studies have produced extensive and detailed datasets, much of that information still must be assembled and converted into geospatial formats that can identify relevant characteristics such as distance from shore, and general depth range to facilitate integration into environmental analyses.

**Objectives:** This study will build on multiple existing efforts to create and share geospatial data and layers, for both immediate use by analysts and ingestion by the BOEM Marine Cadastre and Alaska Ocean Observing System (AOOS) portals. Some of these data layers could be integrated immediately while other data may need to be

processed and converted to a geospatial format before they can be scaled to OCS environmental analyses and integrated into spatial analysis tools.

**Methods:** Geospatial specialists will work with BOEM NEPA analysts and studies personnel to develop a data management framework, including data coverage and scale, based on scientists requirements by discipline (*e.g.*, fisheries and lower trophic communities, seabirds, marine mammals, oceanography). Data visualization, access, and analysis needs for BOEM data resources will also be established. Existing geospatial layers will be adapted to this framework and relevant data in non-geospatial formats will be converted into geospatial coverages. Front-end GUIs and tools will be developed and BOEM staff will be trained in their use. The project will be structured to provide interim products to meet specific upcoming information needs, such as NEPA analysis for the Liberty DPP. Information will be provided to the BOEM Marine Cadastre and other relevant data portals, including ESPIS where practicable. An inventory of datasets for incorporation will be established and prioritized based on information need, level of effort required for processing, and budgetary considerations.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea

**Administered By:** Alaska OCS Region

**Title:** Wave and Hydrodynamic Modeling in the Nearshore  
Beaufort Sea

**BOEM Information Need(s) to be Addressed:** BOEM needs a validated high-resolution wave model and hydrodynamic model outputs to assess current and future wave conditions and their impacts on offshore oil and gas structures and on potential changes in sedimentation patterns and coastal erosion within Stefansson Sound and the nearshore areas of the Beaufort Sea. Specifically, BOEM requires information on the impacts that climate change may have on sea ice, wind and wave conditions, changes in sedimentation rates, and ice pile ups events during the expected timeframe of the Liberty Development Project (~2020–2050). Coordinated field observations are needed for model validation since wave observations are quite limited in the central Beaufort Sea. Results from this study will support NEPA analyses for future lease sales, EPs and DPPs, and inform monitoring activities associated with the planned Liberty Development Project.

**Approx. Cost:** (in thousands) \$1,900      **Period of Performance:** FY 2017–2021

### **Description:**

**Background:** The shallow shelf area in Stefansson Sound is capable of modifying large wave events as they propagate shoreward. Depth refraction, shoaling, and dissipation processes due to shallow water bathymetric effects are difficult to represent in shallow water wave models. The area within Stefansson Sound and Foggy Island Bay are difficult to model due the scarcity of wind and wave information, the complex shallow bathymetry, coastal topography and the highly variable and mobile sea ice conditions. The 100-year return wave height and period are important considerations for the design of offshore fixed structures to support the topside oil and gas facilities. Likewise, rapidly changing climate conditions such as warmer temperatures, stronger winds, and reduced ice cover can adversely impact those shore based facilities through larger, more persistent waves and thawing of permafrost and increased coastal erosion.

This study will produce high resolution wave output in the nearshore region to assess the impacts of waves on sea ice and offshore structures. A coordinated field effort will collect offshore observations using fixed moorings and buoys for validation of the proposed wave model for the Beaufort Sea. Additional field effort will be conducted to map ice pile-up events within Stefansson Sound.

### **Objectives:**

- Obtain a better understanding of the physical processes related to wave simulations within Stefansson Sound, Beaufort Sea, the bottom conditions and depth-induced wave breaking conditions and their effects.

- Assess offshore wave and meteorological conditions within Stefansson Sound and compare those measurements to model results.
- Produce a 20-year wind and wave hindcast reanalysis dataset and document the minimum, mean, and maximum wind-wave events.
- Characterize wave conditions in Stefansson Sound over a 2, 5, 10, 20, and 30 year period based upon the model results and potential reduced sea ice conditions due to climate change.
- Develop a coupled wave-hydrodynamic-sediment transport model to document current sediment transport conditions; forecast changes due to higher waves, stronger currents and diminished sea ice.
- Through field observations, document wave, ice, and erosional conditions within Stefansson Sound and their impacts on offshore and coastal oil and gas facilities during the two years of field effort and compare to past assessments since the 1970s.

**Methods:** This study will develop a new wave model or enhance an existing wave model (*e.g.*, the Simulating Waves Nearshore [SWAN] model) to better simulate near shore wave conditions within the Beaufort Sea. Researchers will validate the model against field-deployed moorings that measure site-specific wave conditions over a two-year field season. The developed wave model will be coupled to a hydrodynamic model to evaluate potential nearshore impacts or changes in sedimentation rates or sites of deposition or erosion related to changes in current and wave energy resulting from construction of a gravel island for oil and gas production on the OCS. This work will be coordinated with ongoing and future research funded by BSEE and BOEM to investigate the dynamics of sea ice freeze-up.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** All Alaska Planning Areas

**Administered By:** Alaska OCS Region

**Title:** Wave Energy Converter Impact Assessment

**BOEM Information Need(s) to be Addressed:** The Energy Act of 2005 delegated regulatory authority to BOEM over renewable energy resources on the OCS. For hydrokinetic energy development, the Federal Energy Regulatory Commission (FERC) manages permit authority for licensing while BOEM retains regulatory responsibilities for leasing and compliance requirements. To achieve complete assessment of the economic feasibility of a wave energy conversion demonstration project already underway off the coast of Yakutat, Alaska, additional environmental data is needed in specific topical areas, including: subsea hazards, seabed sediment dynamics, ambient noise, and local distribution of marine mammals and fish. BOEM and other regulatory authorities will use this newly acquired information to make immediate decisions about the viability and planning of commercial interests in offshore renewable energy projects in Yakutat and other promising locations, including on the OCS.

**Approx. Cost:** (in thousands) \$750

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** Since Alaska has thousands of miles of coastline, the state holds vast potential for tidal and wave energy development. With emerging technologies, these energy resources are becoming more attractive to coastal communities as a potential energy source to diminish reliance on costly diesel fuel. In 2013, FERC approved a preliminary permit application to Resolute Marine Energy to undertake an offshore wave energy feasibility study beyond the surf zone near the City of Yakutat. State and local sources have already funded initial wave energy feasibility studies to determine that the project site does afford excellent deep and shallow water wave resources that can be harnessed by “Surge Wave Energy Converter”™ technology.

Yakutat is a remote community located along the northeastern Gulf of Alaska. Their current power generation is 100% from diesel fuel, which must be barged in, resulting in a high cost of electricity that averages \$.60 per kilowatt hour. The City and Borough of Yakutat, along with tribal leaders, have identified other options to meet their energy needs, including wave energy. Their interest led to an effort in 2009 to launch initial research intended to assess both available wave energy and local environmental factors that would establish the feasibility of advancing a development project using emergent “wave energy converter (WEC)” technology available from the Boston-based company, Resolute Marine Energy. FERC approved a preliminary permit for the project in January 2013 to initiate such feasibility studies. The preliminary project design envisions an array of nine wave converters positioned beyond the surf zone on the seabed in State waters running parallel to shore.

The first phase of the assessment evaluated Yakutat's wave energy resource. The City and Borough of Yakutat funded the UAF Alaska Center for Energy and Power to deploy a bottom-mounted mooring offshore of Yakutat to measure key parameters relevant to the placement of an array of wave energy converters. An Acoustic Doppler Current Profiler recorded surface wave statistics such as wave height, time between wave crests, direction, and speed. Another sensor measuring conductivity, temperature and depth provided data necessary to inform environmental conditions that accompany different wave and current patterns, as well as concurrent studies of local marine mammal populations and fisheries. The second phase of the assessment involved a modeling effort, funded by the Alaska Energy Authority (AEA), to support the installation and operation of the WEC units. AEA funding also supported the development of wave climatology for the greater Yakutat area in order to assess the proper size of the WEC array.

Study results from these two phases indicate that Yakutat wave resources provide "excellent" energy source potential in both deep and shallow water. However, additional data on environmental factors is necessary to assess the economic viability of undertaking the development. In particular, comprehensive assessments are still needed in three specific topical areas: subsea hazards, seabed dynamics, and marine mammals. In 2016, bathymetry and seabed depth work will be funded by the Department of Energy. But information needs are still pressing to characterize seabed dynamics, including areas prone to sediment movement and their implications for benthic habitat. Information needs are also still pressing to characterize ambient underwater noise, as well as presence and habitat implications for local fish and marine mammals. Without BOEM engagement, this demonstration project will remain incomplete and inconclusive, inhibiting renewable energy momentum in Alaska.

#### Objectives:

- Collect scientific and technical data sufficient to complete assessment of the economic feasibility of the Yakutat Wave Energy Project.
- Establish firm scientific understanding of seabed dynamics, ambient underwater noise, and fish and marine mammal presence and habitat requirements in the offshore project area of Yakutat.
- Evaluate implications of findings from the Yakutat Wave Energy Project for feasibility studies in other coastal regions of Alaska, including extensions onto the OCS.

Methods: Work with UAF Alaska Center for Energy and Power, Alaska Energy Authority, DOE, FERC, NOAA, and USFWS to integrate and extend offshore environmental feasibility studies sufficient to fully assess the economic viability of wave energy projects in Yakutat and other areas of coastal Alaska.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea

**Administered By:** Alaska OCS Region

**Title:** Arctic Slope Winter Fish, Invertebrates, and Arctic Cod Spawning Survey

**BOEM Information Need(s) to be Addressed:** BOEM requires spatial and seasonal information about fish in the Chukchi and Beaufort Seas to provide complete and accurate Arctic Essential Fish Habitat and NEPA analyses. A greater understanding of Arctic cod's ecological role as both the most abundant predator and most abundant prey is needed to support analysis of the potential effects of oil and gas exploration, development, and production in the Beaufort Sea ecosystem. The under-studied winter season and the location of suspected Arctic cod spawning habitat is of increasing public concern and this information is especially important for EFH and NEPA analyses, including the potential effects of oil trapped under ice.

**Approx. Cost:** (in thousands) \$5,000      **Period of Performance:** FY 2017–2020

### **Description:**

Background: Arctic fish fill an essential Arctic ecosystem role by consuming small prey and in turn providing a food resource for larger fishes, birds, marine mammals, and people. Isolation of fish from scientific study by thick ice cover during three-fourths of the year and the majority of their lives limits our understanding of Arctic fish ecology.

By virtue of Arctic cod's dominance and ubiquity across the OCS and throughout the water column, it would be difficult to overstate its importance as the primary conduit through which an estimated 93% of lower trophic production funnels to the surface where many higher trophic predators live. To assess direct and cascading effects from potential oil and gas development on Arctic cod, and cumulative effects from climate change, it is important to understand whether this ecologically dominant and critical species is ice-obligate in one or more of its life stages and therefore at risk of extirpation in U.S. waters as the ice recedes. This study will also provide information about the interdependent roles of epibenthic invertebrate prey and the secondarily dominant snailfish, eelpouts, and sculpins, which are even less understood than Arctic cod.

The body of recent research on Arctic cod will inform this project. For example, BOEM-funded genetic studies are elucidating possible on-shore and off-shore genetic stock differentiation for Arctic cod, while open-water surveys underscore the importance of continental slope areas with recent Canadian Beaufort research suggesting Arctic cod spawn on the continental slope. In addition, the large influence of the continental slope biota and oceanography on the continental shelf ecosystem was highlighted by recent BOEM oceanography, fish, and invertebrate surveys that documented increased diversity, abundance and larger sizes along the slope. Alaskan scientists have also implemented an individual-based model that uses oceanographic currents to identify locations of larval Arctic cod caught in BOEM surveys with their likely spawning

grounds. Furthermore, scientists at the Alfred-Wegener Institute recently published on the successful adaptation of nets that can fish directly under the ice, simplifying the logistical challenges of capturing fish in their winter habitats. This recent understanding combined with new research methods have dramatically improved our capabilities, making it more feasible to study fish under winter ice and to search for critical Arctic cod spawning habitat.

This study will improve our understanding of under-ice fish ecology, the fundamental energy transfer role fish play in Arctic food web dynamics to upper trophic predators and how the ecological relationships may be influenced by climate change. Understanding this ice-covered world is of increasing importance as rapid loss of multi-year pack ice is radically altering distributions of marine mammals in the Arctic OCS as they are forced to adapt to climate-related changes in access to prey.

Objectives:

- Establish a winter fish and invertebrate monitoring baseline under the ice along the continental slope in the U.S. Beaufort Sea.
- Increase understanding for relationships among winter fish ecology, trophic interactions, and oceanographic conditions in the U.S. Arctic.
- Identify spawning times and locations of Arctic cod along the Beaufort continental slope and coast.

Methods: This study will conduct under-ice field surveys along the continental slope in the Beaufort Sea to elucidate the seasonal fish distribution and abundance, targeting Arctic cod spawning times and locations in particular. Sampling will also include crab and lower trophic organisms, genetics, energetics, and stable isotopes where possible. The project will engage local coastal residents to participate in the research and provide local and traditional knowledge about winter fish ecology. An Arctic cod spawning workshop including international Arctic cod experts, planned for January 2017, may provide information for refining planned methodologies, as well as opportunities for international collaboration. Collaboration with other agencies will be sought to take advantage of the economy of scale and extend study to the Chukchi Sea.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea

**Administered By:** Alaska OCS Region

**Title:** Variability in Nearshore Buoyancy-Driven Circulation in the Beaufort Sea

**BOEM Information Need(s) to be Addressed:** BOEM needs accurate characterizations of the forces that drive circulation in the central Beaufort Sea to support the forcing and validation of numerical ocean circulation models developed as components of Oil-Spill Risk Analyses (OSRA). On the inner shelf for example, the character of the nearshore hydrographic regime, including buoyancy forcing attributable to river discharge and distributed freshwater sources, is not fully described. Furthermore, large aggregations of feeding bowhead whales are observed at inner-shelf fronts just north of Stefansson Sound, but the physical conditions that produce these fronts are not well understood. Results from this study will support OSRA and other NEPA analyses for future lease sales, EPs, and DPPs in the Beaufort Sea.

**Approx. Cost:** (in thousands) \$2,900      **Period of Performance:** FY 2017–2021

### **Description:**

**Background:** The Beaufort Sea shelf is subject to large annual and interannual variations in buoyancy-forced circulation through the discharges of freshwater from coastal rivers systems and from the freezing and thawing of sea ice. Along the Beaufort Sea coast, stream gauges that monitor river discharges from the Colville and Sagavanirktok rivers (the two largest Alaska contributors of freshwater discharge to the Alaskan Beaufort Sea) are located well upstream from the river mouths and/or on side channels, leaving large areas of these river's watersheds ungauged. Consequently, measured discharges likely under- or misrepresent the total discharge, as well as the distribution of discharge across channels for these watersheds. Further to east, the contribution of freshwater from the Canning River to the nearshore area has not been well-quantified. Without an accurate accounting of the freshwater entering the Beaufort Sea including Simpson and Stefansson Sounds, Harrison Bay and other nearshore regions, including Canadian waters, skillful numerical simulation of inner shelf circulation is problematic.

Recent analyses of bowhead whale data from the BOEM-funded Aerial Surveys of Marine Mammals (ASAMM) combined with river discharge data suggest that hundreds of bowhead whales observed within a few kilometers of the Stefansson Sound barrier islands in 1997 and 2014 were feeding along nearshore fronts attributable, in part, to anomalously large discharges from the Sagavanirktok River during late summer in these years. Accurate accounting of river discharge and distributed freshwater sources would improve our ability to anticipate future occurrences of large aggregations of bowheads along the barrier islands and improve our ability to accurately model nearshore circulation. Both these issues are very important to effective response in case of a contaminant spill from oil and gas developments such as the proposed Liberty project.

## Objectives:

- Use a combination of measured, modeled, and estimated river discharge along the Beaufort Sea coast to provide improved estimates of terrigenous freshwater fluxes to the inner shelf of the Beaufort Sea.
- Characterize the temporal and spatial changes in the nearshore hydrography across Simpson Lagoon and Stefansson Sound and seaward of their barrier islands in response to changes in river discharges and winds.
- Quantify the volume of fresh water from sea ice melt in the nearshore environment.
- Validate Beaufort Sea hydrologic and near shore high-resolution ocean circulation models based upon comprehensive observations.

Methods: This study will develop an improved hydrologic model for the Beaufort Sea coast from the Mackenzie River in the east to the Colville River in the west to improve quantification of freshwater input into the nearshore area. Results will be compared to observations from gauged stations. River stage and discharge measurements will be collected at the mouth of the Colville River, Sagavanirktok River, Canning River, and Mackenzie River (if needed) during both the spring (through ice) and summer periods in order to calibrate hydrologic model parameters and output.

A small boat capable of accessing shallow, nearshore waters will be used to acquire high-resolution (~100 m) cross-shelf CTD transects using a profiling CTD and a towed Acrobat CTD system. Sampling will extend from Harrison Bay across Simpson Lagoon to Stefansson Sound and seaward of their barrier islands to characterize the hydrography under different river discharge and wind conditions. A towed ADCP will map water column velocities at high resolution as well. In addition, a through ice hydrographic study will be conducted to map the extent of buoyant plumes beneath the sea ice within Stefansson Sound during the freshet. ADCP/CTD moorings will be deployed inside Stefansson Sound to capture the year-round ice thickness conditions and circulation. On-ice measurements of sea ice thickness and chemical composition will be conducted during the winter and spring months to estimate the volume of fresh water contribution from sea ice.

Available wind data from coastal weather stations will be compared to reanalysis products for the region to evaluate the best model product for the region. Modeled winds will then be used in conjunction with the hydrographic and mooring data to assess the effects of winds and freshwater fluxes on the nearshore hydrography.

Researchers will work with local communities through the Coastal Community Ocean Observers (C2O2) program to collect oceanographic data along the Beaufort Sea during the entire season. This network could be expanded to include the village of Nuiqsut to gather year round riverine and oceanographic data within the Colville River and delta and possibly within the Canadian sector to collect wintertime oceanographic data on the shallow Mackenzie shelf.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Cook Inlet

**Administered By:** Alaska OCS Region

**Title:** Identifying Sea Otter Abundance, Distribution, and Foraging Patterns in Cook Inlet Alaska, using Unmanned Aircraft Systems (UAS) and Manned Aircraft

**BOEM Information Need(s) to be Addressed:** This study will provide valuable data on sea otter distribution, abundance as well as information about feeding areas utilized by sea otters, and the overlap between important sea otter feeding habitats and oil and gas lease areas essential for pre-lease and post-lease assessments. This research will form baselines for monitoring oil and gas related developments that are undertaken in Cook Inlet. Results from this study will support NEPA analysis and documentation for future Lease Sales in Cook Inlet under the 2017–2022 Proposed Program, as well as NEPA analysis related to EPs and DPPs.

**Approx. Cost:** (in thousands) \$500<sup>3</sup>      **Period of Performance:** FY 2017–2020

### **Description:**

**Background:** Following historical near-extirpation, a remnant sea otter population persisted on the west side of lower Cook Inlet, with nearly 7,000 inhabiting the Kamishak Bay area in 2002. However, sea otters did not reoccupy the east side of the Inlet until the 1960s. By 2002, the year of the last full survey, nearly 1,000 sea otters inhabited Kachemak Bay and by 2012 numbers were estimated to have reached 6,000. Currently, sea otters are thought to be expanding their range north along both sides of Cook Inlet. Seismic survey work in support of potential future oil and gas exploration activity began in 2014 along the east side of lower Cook Inlet moving northward from Anchor Point. However, effects of seismic activities and future oil and gas infrastructure on sea otter behavior and habitat use are not well documented. Decision-makers are keenly interested in understanding potential effects of seismic exploration and oil and gas development activities on sea otters. This study plans to quantify abundance, distribution, and habitat use of sea otters in Cook Inlet, and advance the technological tools needed to efficiently conduct this work. UAS-based surveys have the potential to be cheaper to operate, eliminate human risk inherent in low-level survey flights and may cause less disturbance to sea otters and other marine birds and mammals during operations. In addition, the post-processing nature of UAS-based survey analyses provides the opportunity to quantify other wildlife species encountered during surveys.

A better understanding of the use of lower Cook Inlet by sensitive species including cetaceans, sea otters, pinnipeds, and seabirds is needed to evaluate the potential effects of oil and gas exploration, development, and production in the area. Sea otters are protected under both the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA), and are an important component of nearshore marine

---

<sup>3</sup> plus Joint Funding

communities. Assessment of current sea otter status and quantification of effects of development activities on sea otter behavior and habitat use are needed to evaluate potential consequences of offshore seismic and drilling activities in the Cook Inlet.

Objectives:

- Document sea otter abundance, distribution, habitat use, and foraging ecology in Cook Inlet in relation to oil and gas development activities using UAS and manned aircraft.
- Identify sea otter habitats within Cook Inlet that are of specific importance for foraging, resting, and pup rearing.

Methods: Traditional methods to gather sea otter abundance and forage data rely on manned aerial observations and shore-based observations, respectively. This study will use these traditional aerial survey methods while also developing and applying methods using UAS technology, which holds great potential for efficient, safe, and un-biased collection of survey and foraging data. This will allow for a robust estimation of otter abundance using a proven census technique (manned aerial surveys) and allow a validation of a new method (UAS). This study will use traditional manned aerial surveys and forage observation methods to document the current status of sea otters in Cook Inlet that will serve as a baseline for future comparisons of similar UAS-derived data. Preliminary UAS work conducted in spring 2015 in cooperation with the Alaska Center for Unmanned Aircraft Systems Integration (ACUSI) demonstrated that sea otters were relatively tolerant of small rotary-wing unmanned aerial vehicles (UAVs) hovering overhead, indicating that collection of offshore sea otter forage data from a UAV carrying a high resolution camera in the OCS is feasible.

Research goals include choosing optimal sensors that can capture high-definition observational data and fine-tuning UAV-based data acquisition methods. UAV-based forage observation methods will eliminate the nearshore bias of land-based foraging observation methods, and will allow identification of important offshore foraging habitat in Cook Inlet. Survey development will include choice of sensor(s), flight pattern optimization, and development of statistical procedures to account for diving sea otters unavailable during single overpasses. UAS-based surveys will allow cost-effective sea otter surveys at the temporal and spatial scales (*e.g.*, daily at 100 km<sup>2</sup>) necessary to document sea otter distribution and use patterns (*e.g.*, “hot-spots” of persistent use) before, during and after seismic surveys and oil and gas exploration activities. In addition, the lower cost of UAS surveys will allow multi-replicate, seasonal abundance surveys in lower Cook Inlet that will document changes in sea otter distribution and hot-spot patterns in the presence of drilling platform infrastructure. Importantly, UAS-based surveys will provide economical collection of distribution information on sea otters and other marine species even before statistical methods for abundance estimates are finalized. The combination of survey and forage data will allow assessment of the effects of oil and gas activities on sea otters and potentially other marine mammal and bird species. Ultimately, we anticipate that UASs will be used exclusively for collecting these data in the future.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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:** 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. 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 impact of potential oil spills. 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 new study will be used to support environmental analyses for potential future lease sales and exploration, development and production activities in Cook Inlet.

**Approx. Cost:** (in thousands) \$1,460      **Period of Performance:** FY 2017–2021

### **Description:**

**Background:** 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. 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. Anecdotal reports suggest that major ecosystem changes have occurred, including rather large changes in ocean temperature from warm to cold and back to warm that may influence 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.

Additionally, in the winter of 2015/2016 there has been a massive die-off of Common Murres, possibly due to starvation. Murre die-offs have occurred in previous winters, but not in the numbers Alaska is seeing. 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 four years.
- Assess foraging behavior (diets, feeding rates, foraging time) at the three colonies
- Census current populations of murres and kittiwakes at their colonies in lower Cook Inlet, and assess average levels of annual production over four years.
- Compare findings for fish and seabirds with data collected in 1995–1999, and relate trends to long-term environmental changes in ocean climate.

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 (CPUE, catch composition) and acoustic surveys (biomass in MT/km<sup>2</sup>) 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. USGS researchers will coordinate and collaborate with the NOAA Kasitsna Bay Laboratory in collection of oceanographic data, and provide all data to the NOAA Kachemak Bay National Estuarine Research Reserve data archives.

At the colonies researchers 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. If USGS researchers obtain supplementary funding from other sources (*e.g.*, EVOSTC, NPRB) the work may be expanded to monitor foraging time budgets at colonies, and resume banding studies to measure annual adult survival rates of murres and kittiwakes. Researchers 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 within and between decades of study, and relating trends in birds and fish to directly measured local changes in the environment (*e.g.*, temperature, salinity) and to larger scale indices of climate change (*e.g.*, ENSO, Pacific Decadal Oscillation, Global Warming Trend). It will be important to quantify these sources of natural variability to evaluate possible future trends under different climate scenarios, and distinguish these from potential direct human impacts of OCS oil and gas exploration and development or oil spills in Cook Inlet.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea, Chukchi Sea

**Administered By:** Alaska OCS Region

**Title:** Polycentric Governance in Barrow, Nuiqsut, and Wainwright

**BOEM Information Need(s) to be Addressed:** The Alaska OCS Region needs a finer grained understanding of the complex institutional arrangements that arise in Arctic coastal communities to assess how local governance institutions might be unexpectedly affected by oil and gas exploration, development, and production. A retrospective analysis of recent Shell Offshore exploration activities may offer an opportunity for insights into this type of social process. The information will support NEPA analysis and documentation for Beaufort Sea Lease Sales and DPPs, as well as the 2017–2022 Five Year Program. It can also be used more broadly in other endeavors, for example, to inform BOEM of community/tribal/North Slope Borough dynamics, which could enable a better understanding of multifaceted governance and promote better working relationships at local and regional scales.

**Approx. Cost:** (in thousands) \$450      **Period of Performance:** FY 2017–2020

### **Description:**

**Background:** On the North Slope of Alaska, multiple institutions of governance exist at different scales. Local authorities with overlapping jurisdictions minimally include (1) the local office of the Alaska Native Claims Settlement Act (ANCSA) regional corporation; (2) the ANCSA village corporation office; (3) the borough offices (equivalent to the county seat in other parts of the U.S.); (4) the city government, (5) the community tribal organization office; (6) the regional tribal organization; (7) the Alaska Eskimo Whaling Commission office (AEWC); and (8) the school district.

This study is intended to clarify the relationships of decentralized, but often shared, governance structures in Alaskan coastal communities. The study will investigate the extent to which complementary multiple authorities exist at scalar levels of governance to offset limitations, and will produce a unique analysis of how situated actors at different levels of governance opportunistically interact and influence each other's decision-making (Anderson and Ostrom, 2007).

The purpose of the study is also to (1) delineate and assess the structural and functional facets of these institutional arrangements; (2) assess the resiliency and vulnerability of polycentric arrangements; (3) assess the prevalence of polycentrism in mixed cash-subsistence economies; (4) identify functional linkages between polycentric arrangements with subsistence harvest. A better grasp of the multiple authorities and linkages between formal and informal arrangements can provide an over-arching insight into the resiliency on a multi-scalar level.

## Objectives:

- Improve the capacity of BOEM analysts to forecast the broad range of socio-economic impacts of offshore energy exploration activities on coastal community institutions and residents.
- Retroactively identify direct and indirect effects of Shell Offshore exploration activities on formal governance institutions and Alaska Native residents in select communities.

Methods: This study will involve establishing a systematic inventory of institutional entities in Barrow, Nuiqsut, and Wainwright that operate at multiple scales. It will use established ethnographic methodologies to (1) Coordinate with the NSB and study communities to obtain concurrence and support; (2) Conduct a literature search of polycentric systems and the applicability for assessing Beaufort Sea communities; (3) Conduct ethnographic research; (4) Develop a rigorous analytic method to evaluate the functionality of the institutional arrangements, especially in a mixed cash-subsistence economy, such as the “Institutional Analysis and Development” framework (Ostrom, 2010); (5) Explain any documented changes by reference to fieldwork and published literature; (6) Explain the differences and similarities of the institutional arrangements in the three study communities and if they are interdependent or independent; (7) Assess how effectively these institutional arrangements contribute to resilience or vulnerability of a study community; (8) Describe the effects of Shell’s interaction with multiple authorities on a multi-scalar level to obtain a finer grained baseline that would describe possible outcomes in future NEPA analyses; (9) Assess how the arrangements adapt to changing circumstances; and (10) document findings in a comprehensive report.

## **References:**

Anderson, K. and E. Ostrom. 2007. An Analytical Agenda for the Study of Decentralized Resource Regimes. Prepared by Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program, Office of International Research, Education, and Development, Virginia Tech.

Ostrom, E. 2010. Beyond Markets and States: Polycentric Governance of Complex Economic Systems. *American Economic Review* 100 (June 2010): 1-33.

**Revised Date:** April 12, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Alaska OCS Region

**Title:** Marine Bird Distribution and Abundance in Offshore Waters

**BOEM Information Need(s) to be Addressed:** This project will provide basic information on distribution, abundance, and habitat requirements of marine birds, necessary to assess potential effects of oil and gas exploration, development and production in the Chukchi Sea, Beaufort Sea, and Cook Inlet Planning Areas. Results from the project will support ESA Section 7 consultations and NEPA analyses for potential future lease sales and DPPs. The information obtained from these surveys may assist in development of mitigation measures and strategies to reduce potential impacts on listed and candidate species under the ESA (Spectacled Eider, Steller's Eider, Short-Tailed Albatross, Yellow-billed Loon) as well as Priority Species identified by the USFWS (11 Tier-1 species and 14 Tier-2 species). By collaborating with multi-disciplinary vessel-based projects, it will be possible to make linkages between physical and biological factors that influence the distribution of marine birds.

**Approx. Cost:** (in thousands) \$500<sup>4</sup>      **Period of Performance:** FY 2017–2021

### **Description:**

**Background:** Seabirds are wide-ranging apex predators and good indicators of changes in marine ecosystems. Seabirds spend most of the year offshore, yet our information needs are greatest for the pelagic aspect of their lives. To address these needs, an At-sea Seabird Observer Program was initiated by the U.S. Fish and Wildlife Service with a grant from the North Pacific Research Board (Project 637; 2006–2008) and continued as part of the Bering Sea Study (B64; 2008–2010) and by an inter-agency agreement with BOEM (AK-10-10; 2010–2015) to provide marine bird data for areas of oil and gas activity. In total these surveys provided > 200,000 km of survey effort to the North Pacific Pelagic Seabird Database and resulted in marine bird distribution files and multiple publications relevant to BOEM requirements for NEPA and other Environmental Assessments in offshore waters. Among the published findings: seabird and marine mammal 'hotspots' in the Chukchi Sea; evidence of shifts in distribution and species composition in the Bering and Chukchi Seas; new information was also obtained on seasonal changes in seabird distribution and on locations of molt areas for several alcid species. Additionally, BOEM has partnered with USFWS in Cook Inlet as part of the GulfWatch Alaska program in 2014–2015. Because of observed and on-going climate change, it will be important to document shifts in species distribution, particularly following the exceptionally warm 2014 and 2015 years, with predicted warm conditions in 2016–2017.

Basic information on timing and duration of use within designated Chukchi and Beaufort Seas Planning Areas is necessary to better define the impacts of perturbations

---

plus Joint Funding<sup>4</sup>

and ultimately population effects. Breeding seabirds are generally monitored at colonies, yet they spend most of the year dispersed offshore. Additionally, one half or more of all seabirds do not breed in a given year, thus management of marine birds requires knowledge of spatial and temporal patterns of seabird distribution at sea.

Objectives:

- Estimate the spatial distribution, species composition and seasonal changes in species and estimate abundances for marine birds in designated and potential planning areas.
- Process the data for entry into the North Pacific Pelagic Seabird Database for future accessibility and facilitate management decisions for marine bird use of planning areas.
- Examine trends in abundance of key species by comparison to 1993 and 1995-99 for Cook Inlet, and for Kachemak Bay, relative to 2005–2007 and 2011. These historic data and the newly collected observations will be used to determine if there have been changes in marine bird distribution.
- Examine the effects of environmental drivers (climate and oceanographic conditions) as well as biological drivers (prey availability) on seabird distribution by collaborating with researchers who collected oceanographic and biological data during the same research cruises.

Methods: This project will build off of established methods for an at-sea survey program, to opportunistically collect distribution data on seabirds via partnership and collaboration among the USFWS, NOAA-Fisheries and other vessel-based monitoring or research programs. Observers will conduct visual surveys using established protocol (strip transect or modified distance sampling) to identify all marine birds and mammals while a vessel is in transit. Data is entered directly into a computer with location data (latitude and longitude) along with associated environmental conditions. Data is processed and submitted to the North Pacific Pelagic Seabird Database by converting counts into densities (birds/km<sup>2</sup>). Five data sets (time series) will be compared for abundance trends and analyzed for changes. The report will discuss how environmental drivers relate to spatial distribution and abundance of key species and discuss whether climate change is affecting listed species or document other potential causes (reduced breeding habitat, *etc.*).

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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; EFH and ESA analysis and consultation; 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) \$150**      **Period of Performance:** FY 2017–2019

### **Description:**

**Background:** The state of Arctic marine knowledge now makes possible the practical use of foodweb simulation models. 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 assess 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 to assess proportional influence of changes on ecosystem processes to better evaluate and mitigate potential impacts. This study would also 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.

**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:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Chukchi Sea

**Administered By:** Alaska OCS Region

**Title:** Extension of the Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring

**BOEM Information Need(s) to be Addressed:** BOEM needs a rigorous monitoring system to improve information about the health of biodiversity in the Chukchi Sea as a means to enhance environmental impact assessments and develop better metrics for cumulative impact analysis. Biodiversity measures for the marine environment need to be acquired through systematic and comprehensive methodology. Developing a biodiversity observing network can fulfill these objectives and serve as a prototype for other regions. The initial phase of AMBON was funded through the National Oceanographic Partnership Program (NOPP). Continuation of the program is necessary to accomplish the goals of sustained biodiversity observations to inform assessments of OCS energy development, management and decision-making related to oil and gas lease sales and potential future exploration, development and production, as well as monitoring of resources for invasive species and climate-induced changes that affect ecosystem functioning.

**Approx. Cost:** (in thousands) \$1,500      **Period of Performance:** FY 2018–2021

### **Description:**

**Background:** Biological diversity is defined as the variety of life, encompassing variation at all levels of complexity – genetic, species, ecosystems, and biomes – and including functional diversity and diversity across ecosystems. A growing body of research demonstrates that: (1) the maintenance of marine biodiversity (including coastal biodiversity) is critical to sustained ecosystem and human health and to resilience in a globally changing environment; and (2) the condition of marine biodiversity offers a proxy for the status of ocean and coastal ecosystem health and the ability to provide ecosystem services. This study would provide information to enhance management against threats such as invasive species and infectious agents, enable predictive modeling, better inform decision-making, and allow for adaptive monitoring and Ecosystem-Based Management.

While the knowledge of marine biodiversity has greatly increased over the last decade, we are lacking systematic and sustainable approaches to observing and monitoring biodiversity across different levels and at a national scale. In 2014, a Marine Biodiversity Observing Network (BON) was established for the Chukchi Sea through the National Oceanographic Partnership Program (NOPP), with partnerships from BOEM, NOAA, and Shell Industry. The Arctic Marine Biodiversity Observing Network (AMBON) project, led by the University of Alaska Fairbanks, is an end-to-end marine BON. “End-to-end” refers to integration of observations and historical data across multiple scales of diversity (genetic to ecosystem, microbes to whales), time (instants to centuries), and space (in situ to satellite remote sensing). The initial phase of the

AMBON project is working to establish the metrics to be measured, define temporal and spatial scales of measurements, initiate an Arctic network through data sharing, and contribute to a national effort to create a national BON prototype.

To be a useful tool in managing marine resources, mitigate human-induced or climate-related impacts, and provide sound basis for risk assessment, continuous data are necessary through a sustained monitoring network. The assessment of possible adverse impacts from OCS energy development hinges on being able to differentiate human-induced effects from natural variability. Given the complexity of marine ecosystems and the possible effects of global climate change, this often requires making observations over large ocean areas seasonally, and especially making the observations continually over multiple years and even decades to acquire reasonable statistical confidence.

**Objectives:** The objective of this study is to build on emerging Distributed Biological Observatories (DBOs) and the initial phase of the AMBON project by developing a prototype ecosystem-based marine biodiversity network over the Chukchi Sea Planning Area, monitoring multiple trophic levels and species. Informed by historical data, past modeling efforts, and the initial field work of the AMBON project, the network will: expand upon planned and recently-launched observing sites, systems, and programs; employ innovative techniques for data discovery and methods that dynamically interrelate data sets to add value to existing monitoring data; and collaborate with the U. S. Integrated Ocean Observing System (IOOS) participants and funding agencies to optimize data management and modeling capabilities.

**Methods:** AMBON employs an end-to-end approach, studying biodiversity from microbes to whales. The approach is through field work of sampling all biodiversity components along a fixed station grid (see [www.ambon-us.org](http://www.ambon-us.org)). Current funding supports field work in 2015 (completed) and 2017. Additional funds will be used to continue field observations along this sampling grid in 2018 and 2019 to continue time series.

Specific ecosystem components that will be sampled include: hydrographic conditions, water column chlorophyll and phytoplankton, zooplankton, water column and sediment microbes, sediment macro-infauna, benthic epifauna, pelagic and demersal fishes, seabird, and marine mammals. Samples will be collected with traditional CTD, nets, grabs, and through observations. Biological samples will be processed to the highest taxonomic resolution possible. Biological data will be linked to environmental data collected concurrently, and also to mooring data in the sampling region. Data will be analyzed for each biological component, but also in an ecosystem approach (Do all components show similar trends? What are the temporal and spatial scales of variability?, *etc.*). In addition, AMBON-produced data will be linked to existing data streams from past and other ongoing research efforts through the AOOS database network to assess the full suite of biodiversity in the system and to elucidate longer-term trends, where possible. Information on AMBON and its results will be presented through scientific conferences, peer-reviewed publications, and also public lectures and other outreach venues to a wide variety of stakeholders.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 and Beaufort Sea OCS

**BOEM Information Need(s) to be Addressed:** BOEM needs to develop new data analysis methods to improve sea ice forecasting capabilities and to document a “trigger date range” for determining the end of the drilling season in response to submitted exploration plans for the OCS in the Chukchi or Beaufort Seas. BOEM analysts and managers seek more detailed spatio-temporal atmospheric, oceanographic, and sea ice data pertaining to seasonal freeze-up conditions in the vicinity of specific planned drilling locations on the Alaska OCS. More reliable and extensive information is particularly needed during the late open-water season and during the seasonal freeze-up period when frazil ice formation can create environmental concerns regarding response to spilled oil. Additional information pertinent to understanding the physical processes associated with freeze-up and associated forces that greatly impact Arctic OCS operations is also needed. Study products will support NEPA analyses, including EISs and EAs for EPs and DPPs, and other BOEM decision-making needs.

**Approx. Cost:** (in thousands) \$4,000      **Period of Performance:** FY 2018–2022

### **Description:**

**Background:** Real-time information on ice, ocean and weather conditions, along with improved ice forecasts for the Beaufort and Chukchi Seas, 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.

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 estimated date of first ice encroachment over the drill site derived from historical data. In December 2014, BOEM analyzed 10 years (2005–2014) of National Ice Center interpreted sea ice data to calculate a range of dates that ice would first encroach within

30 km of the proposed Burger drilling location planned for the 2015 open water drilling season in the northeast Chukchi Sea. The ice encroachment date for all years, ranged between October 24<sup>th</sup> and November 13<sup>th</sup>. From those dates, BOEM calculated a median date of first ice encroachment and called it the “trigger date”. The trigger date was November 2<sup>nd</sup> for the proposed Burger drilling location. In 2015, at the end of the drilling season, BOEM calculated a final ice encroachment date of November 13<sup>th</sup>. Therefore, the first encroachment of sea ice in 2015 was eleven days later than the “trigger date”, but fell within the maximum range of ice encroachment dates, based upon our analysis of ten years of sea ice data. Therefore, BOEM needs to improve its data analysis and methodology to more accurately produce a “trigger date” or “trigger date range” to account for the variability in sea ice conditions that can occur in a given drilling season. This “trigger date range” could be adjusted during the drilling season based upon an up to date forecast of sea ice conditions for the area.

#### Objectives:

- Document the atmospheric and oceanographic conditions that initiated freeze-up conditions on the northeast Chukchi shelf between 2006 and 2015.
- 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 2007 and 2016 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.
- Develop improved “weather scale” forecasts of freeze-up conditions for the OCS in the Beaufort and Chukchi Seas in coordination with BOEM, BSEE, the National Weather Service forecasters, National Ice Center ice analysts and NOAA modelers.

Methods: Researchers will collect and analyze historical ocean, ice, wave and atmospheric field data (2007–2016) 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.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Alaska OCS Region

**Title:** Assessment of Multiple Ocean Circulation Models to Support Ensemble OSRA Experiments

**BOEM Information Need(s) to be Addressed:** Oil-Spill-Risk Analysis (OSRA) is a cornerstone foundation for evaluating alternatives in OCS oil and gas leasing NEPA analyses and oil spill response plans. This study would support continuing improvement of the BOEM oil-spill trajectory model and its application in the Arctic and provide additional baseline information for NEPA analyses. Oil-spill issues constitute a significant portion of public comments submitted on NEPA documents related to proposed lease sales, EPs, and DPPs in the Alaska OCS Region.

**Approx. Cost:** (in thousands) \$450

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** To assess potential changes in the marine and coastal environment associated with offshore oil and gas development activity, it is important to understand how key environmental variables (*e.g.*, surface winds, oceanography, and sea ice) fluctuated in the past and are predicted to act in the future in association with climate variations. To maintain its state-of-the-art in oil-spill-trajectory analysis, BOEM seeks to take advantage through time of the increasing skill of circulation models supported by more and better data. Over the past decades, BOEM and other Federal and State agencies have invested a significant amount of resources to measure and model the circulation and variability in the Alaska coastal waters. It has been an ongoing challenge to converge on a well-validated and finer-scale ocean circulation model. Modeling the coastal circulation around Alaska is particularly challenging given its complex coastline, rapidly changing weather conditions and the relative large freshwater input from river discharge and melting ice. As a result, any single model hindcast likely has large uncertainties, and a systematic effort is required to validate these hindcast model simulations against available measurements. A multi-model ensemble is the ultimate approach to providing retrospective analyses and estimating model uncertainties for surface wind, ocean currents and waves, and sea ice in Alaska coastal waters.

### **Objectives:**

- Assess the performance and estimate the uncertainty of simulations of ocean currents and sea ice in Alaska coastal waters from multiple ocean circulation models.
- Apply short-term surface fields from multiple ocean circulation models for the Arctic to identify the physical processes most important to oil-spill trajectory analysis and evaluate sensitivities of the various models to relevant parameters.

**Methods:** This study will assemble model simulations for ocean currents and sea ice from multiple ocean circulation models to support ensemble and inter-comparison OSRA experiments. Observational data sets will be assembled and aggregated from a variety of sources to facilitate data-model comparisons. Sensitivity analyses may be conducted to evaluate various parameterizations relevant to OSRA within the individual models. Local observations include flow measurements from acoustic Doppler current profilers and drifters and water mass data from conductivity-temperature-depth (CTD) profilers. Deliverables would include a report outlining the strengths and weaknesses of each model in relation to processes relevant to oil-spill trajectory analysis, as well as short-term (five years) surface circulation fields from the suite of models.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Cook Inlet

**Administered By:** Alaska OCS Region

**Title:** Year-Round Marine Mammal Distribution in the Lower Cook Inlet Region

**BOEM Information Need(s) to be Addressed:** BOEM needs updated information to establish occurrence and distribution of several species of marine mammals, including multiple endangered species. This study will provide data to support evaluations of the potential effects of oil and gas exploration, development and production activities on marine mammals as required under NEPA, the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). Increased understanding of the seasonal distribution of the relevant species will assist BOEM in NEPA assessments for lease sales, EPs, and DPPs, design of temporal and spatial mitigation, and monitoring of effects of oil and gas activities. It will also assist with long-term efforts to apply the best available science to adaptively manage and minimize potential effects of oil and gas activity on cetaceans. Results will also support future ESA Section 7 consultations and recovery actions, and help promote recovery of endangered Cook Inlet beluga whales.

**Approx. Cost:** (in thousands) \$2,200      **Period of Performance:** FY 2018–2021

### **Description:**

**Background:** There are at least a dozen species of marine mammals that occur within lower Cook Inlet, which is the area of principal interest for OCS oil and gas exploration and development. This area overlaps with Cook Inlet beluga critical habitat, and what little is known of this species' winter distribution from scarce sightings and passive acoustic data indicates they are present within the area. Several proposed recovery tasks will benefit from an improved understanding of Cook Inlet beluga winter habitat use. Endangered fin and humpback whales are known to be present and to feed in this and adjacent areas in significant numbers year-round, and feed intensively within and downstream of this area seasonally. Detection of the critically endangered North Pacific right whale in the bays of eastern Kodiak Island, and historical data showing catches along the southern entrance to Shelikof Strait and near the Barren Islands, demonstrate the potential presence of this ESA listed species. However, recent studies were inadequate to establish if North Pacific right whales occur in or near lower Cook Inlet. Blue whales are resident in the deeper waters of the Gulf of Alaska and may occasionally pass through the deeper portions of lower Cook Inlet and Shelikof Strait. This study will add to our collective knowledge of year-round distribution of sei, gray, killer, and minke whales, and harbor and Dall's porpoise.

Some species of cetaceans may be adversely affected by routine operations associated with OCS oil and gas exploration and development, including seismic surveys, drilling, production and shipping. Data indicate that underwater noise associated with high-energy seismic exploration may cause some cetaceans to avoid areas where seismic

exploration is occurring. Other types of activity associated with oil and gas development may disturb and modify the behavior of cetaceans, hamper their ability to communicate, navigate, forage, or avoid predators, or put them at risk from ship strike.

Objectives:

- Document the year-round spatial and temporal distribution and relative abundance of cetacean populations within the lease area, from Kalgin Island in lower Cook Inlet to the northern portion of Shelikof Strait.
- Document cetacean migratory paths and access routes to the area of principal interest in lower Cook Inlet through year-round monitoring off the Barren Islands and southwest entrance of Shelikof Strait.
- Document spatial and temporal use of the area by endangered Cook Inlet beluga whales.

Methods: This study will provide documentation on the temporal and spatial distribution of cetaceans in lower Cook Inlet and access areas through continuous year-round passive acoustic monitoring. Two types of long-term acoustic moorings will be used: deep, broad-band, linear moorings for detection of all marine mammal species and shallow, low-profile, narrow-band moorings for detection of beluga echolocation. A total of 7–9 moorings will be deployed both within the lower Cook Inlet area of interest (objective 1) and outside of this area (objectives 2 and 3). Moorings will be deployed in year 1 and turned around every six months to reduce potential mooring loss and to allow continuous year-round monitoring at maximum sampling rate, until they are retrieved in year 3. Recordings will be analyzed to assess the interannual variability in the spatio-temporal distribution of all calling and echolocating marine mammals, vessel and airgun signals, and ambient noise. Habitat and seasonal importance will be defined based on the duration of acoustic encounters for each species. Furthermore, collocation of moorings with biophysical instrumentation to evaluate how oceanographic parameters and prey availability affect distribution and habitat use of the above species may be considered if available funding is sufficient.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Bering Sea, Chukchi Sea, Beaufort Sea

**Administered By:** Alaska OCS Region

**Title:** Ice Seal Movements and Foraging: Village-based Satellite Tracking of Ringed and Bearded Seals (Extension)

**BOEM Information Need(s) to be Addressed:** This study is an extension of a currently funded telemetry project regarding ringed and bearded seal movements and feeding areas in the Beaufort, Chukchi and Bering Seas. More information is needed on seal movements and feeding areas relative to areas of interest for oil and gas leasing, exploration and development. Specific information needs include seasonal movements; fidelity to summer, winter, and breeding areas; location of important feeding habitats; and the degree to which seals are pelagic in summer. In preparation for winter and for the spring pupping and breeding season, seals gain weight in late summer through fall and winter, therefore knowing movements and habitat use during this time period is especially important. Study results may be used to design monitoring and mitigation measures and will support NEPA analyses for lease sales, EPs, DPPs. Since ice seals have been petitioned for listing under the ESA, information from this study also may prove especially useful for future ESA Section 7 consultations.

**Approx. Cost:** (in thousands) \$1,900      **Period of Performance:** FY 2018–2021

### **Description:**

**Background:** A previous satellite telemetry study of seals tagged in Kotzebue Sound showed large scale movements of both species and all age classes. During the current BOEM study local seal hunters from Bering and Chukchi Sea communities were trained to capture and tag seals with satellite transmitters. This allowed for distribution of tagging locations throughout the species' range to provide a broader understanding of seal movements than information gained from tagging in one location only. As of 16 November 2015, tracking of 6 ringed seals has covered an average of 297 (range 83–511) days and tracking of 12 bearded seals has covered an average of 139 (range 11–414) days. These tagged seals regularly travel long distances that have included the Bering, Beaufort, and Chukchi Seas and they have been tracked from Alaska to Russia and Canada. A total of 7 seal hunters from 6 villages have now been trained and supplied with capture equipment and tags so that the capacity for seal tagging has recently been greatly expanded. By early 2017, another 3 hunters will be trained in an additional 3 villages creating a well-trained, effective and motivated team prepared to tag approximately 20–30 seals per year during 2017–2020. By extending this project we can take advantage of the most widely distributed and experienced seal tagging team available to date and collect the data needed for a general understanding of the movements and habitat use of two ice seal species (ringed and bearded seals) with important habitats in the Bering, Chukchi, and Beaufort Seas off Alaska and beyond. By continuing to work with the hunters and their communities we can also add to the documentation of traditional and local knowledge (TK) during a time of great change in the marine environment. Collections of TK to date have provided information valuable

to oceanography (changes in currents), meteorology (more wind, bigger storms), climatology (fewer pressure ridges in winter ice), biology (more seals hauled out on land), and sociology (hunters need to be ready because the seal hunting season is shorter now).

With additional satellite telemetry data we can analyze these extensive movements using oceanographic models. Long distance movements made by seals might be influenced by the velocity and direction of currents. Furthermore, if fish are more likely to be found along fronts and stratified layers, such oceanographic features may also attract seals. If such relationships exist we will quickly gain a greater understanding of seal movements with possible predictive capabilities.

#### Objectives:

- Work with 10 previously trained seal hunters to capture and tag up to 15 ringed and 15 bearded seals per year at multiple locations in the Bering and Chukchi Seas.
- Using satellite telemetry with CTD tags, document the movements, diving behavior, and habitat use of ringed and bearded seals, including use of lease sale areas, patterns and timing of movement through Bering Strait, fidelity to winter and summer areas, use of sea ice, and identification of feeding areas.
- Collect additional local and traditional knowledge to better understand seal movements and habitat use relating to climate change from a local perspective.
- Analyze seal movements using oceanographic models to explain seal movements throughout their range.

Methods: During the current BOEM funded project, a total of 7 seal hunters have been trained to capture and tag ringed and bearded seals near their communities. These hunter-taggers are now experienced and effective at deploying satellite transmitters. They use their own boats and experience and know where and when to find seals. They can evaluate the local weather and ice conditions and take advantage of conditions immediately and more efficiently than non-local biologists can, making the study extremely efficient and cost effective. Oceanographic models, include information on current velocity, current direction, and the location of salinity and temperature fronts, are available. Seal movements can be analyzed relative to these oceanographic variables to evaluate any potential relationships.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea

**Administered By:** Alaska OCS Region

**Title:** Impact Assessment of Kaktovik Whaling Activities

**BOEM Information Need(s) to be Addressed:** BOEM needs information about the fall Kaktovik subsistence whaling effort to provide a basis for evaluation of potential effects from offshore oil and gas activities in the Beaufort Sea. Using the Cross Island whaling mitigation and monitoring as a model, this study will involve long-term monitoring engaging the participation of Kaktovik whalers to document potential effects of oil and gas exploration and development activities on Kaktovik offshore subsistence hunting. The information from this study will support NEPA analysis and documentation for lease sales, EPs, and DPPs in the Beaufort Sea.

**Approx. Cost:** (in thousands) \$650

**Period of Performance:** FY 2018–2022

### **Description:**

**Background:** The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA), which began in 1999, and its continuation (cANIMIDA) provided baseline data and monitoring results for Cross Island subsistence whaling in the vicinity of oil industry development in the Beaufort Sea OCS. The Northstar and Liberty prospects were monitored prior to development, and Northstar was monitored through construction and into production. Currently, BOEM is preparing an EIS evaluating a development plan for the Liberty prospect that would construct an island in Foggy Bay and pipe oil to shore to connect with the Badami Pipeline.

This study will monitor subsistence whaling activities occurring from Kaktovik. It should be noted that unlike the Nuiqsut fall whaling camp at Cross Island, whaling occurs directly from the community of Kaktovik. Global positioning units to map subsistence tracks in the marine environment have never been deployed in Kaktovik, and would be used to identify boat tracks, whale sightings, and takes. Efforts will also be made to capture offshore hunting tracks for animals other than bowhead whales, to the extent practicable.

### **Objectives:**

- Assess the variability in Kaktovik subsistence whaling over time to evaluate the degree to which local conditions (*e.g.*, ice, weather) result in variability in spatial extent, duration of the season, and success.
- Evaluate potential effects of oil and gas exploration and development activities in the Beaufort Sea on Kaktovik whaling and other offshore subsistence activities.

**Methods:** This study will conduct systematic observational and interview data collection from local informants including:

1. number of whales taken;
2. GPS location of whale tracks, sightings, and strikes, with direction and distance from Kaktovik;
3. number and composition of crews;
4. periodic “census” of whaling participants from Kaktovik;
5. duration of whaling season by active days;
6. number of days that weather or sea states confined crews to shore;
7. timing of whaling;
8. length of trips and area searched while whaling;
9. records of catch per unit effort; and
10. observations of whaling participants.

The study will also record information about non-whaling subsistence activities in and near Kaktovik and observations of local subsistence users. Hard copy maps should be appended as necessary for clarification of location information. Study products will include annual reports of information on harvest levels and locations of subsistence resources taken on or near Camden Bay in both tabular and geospatial formats.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea, Chukchi Sea

**Administered By:** Alaska OCS Region

**Title:** Integration of Aerial Survey and Passive Acoustic Seasonal Distribution Data for Arctic Marine Mammals and Anthropogenic Noise Sources

**BOEM Information Need(s) to be Addressed:** This study will provide an integrative long-term marine mammal occurrence analysis from two different but complementary sampling methods and noise footprints from activities related to OCS oil and gas development. These integrated data can help improve mitigation efforts to reduce possible impacts to marine mammals from offshore oil and gas exploration, development and production 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 other reviews for BOEM decision-making in the Beaufort and Chukchi Seas.

**Approx. Cost:** (in thousands) \$750

**Period of Performance:** FY 2018–2020

### **Description:**

Background: There is a need to integrate long-term, basin-wide marine mammal and noise results obtained by different but complementary studies to improve Federal agency compliance with several key U.S. laws.

Long-term marine mammal occurrence in the U.S. Arctic has typically been described by aerial-based visual observations or detections from acoustic moorings. These methods provide different types of information and are affected by different biases. Visual surveys can provide accurate information on species identification but are temporally constrained due to weather and are limited to individuals located at the water's surface when the aircraft surveys the area. Passive acoustic monitoring can continuously sample the environment for actively vocalizing individuals, but acoustic detections are spatially constrained to the mooring detection radii of actively vocalizing individuals. By integrating information from concurrent sampling periods, the strengths of each method can be combined to better understand the spatial and temporal distribution of marine mammals in the Alaskan Arctic. Results on the seasonal distribution of arctic marine cetaceans (including bowhead, gray, humpback, fin, minke, killer, and beluga whales), and pinnipeds (walruses and ice seals) will be synthesized on a large spatial and temporal scale spanning the majority of the U.S. Arctic over the period of 2010–2015.

Long-term analysis of ambient noise typically does not include identification of noise sources and their spatial distribution. By combining extensive aerial survey and long-term passive acoustic recorder effort, changes in ambient noise levels can be attributed to sighted sources (*e.g.*, vessels, seismic sources, platforms, *etc.*). If noise sources are sighted and their radiated noise identified in the acoustic data results, their temporal

and spatial acoustic footprint can be approximated, and their contribution to the inter-annual variability in ambient noise levels can be estimated.

**Objectives:** The overarching goal of this study is to integrate and synthesize data collected through aerial surveys and passive acoustic monitoring in the U.S. Chukchi and Beaufort Seas. Specific objectives include:

- Merge standardized marine mammal seasonal presence (marine mammal time presence units) from visual and acoustic effort into a grid system spanning the entire sampled area.
- Identify concentration areas for gray, beluga, and bowhead whales (and potentially other visually/acoustically identifiable marine mammals) across the period 2010–2015 in the U.S. Chukchi and Beaufort Seas.
- Approximate the acoustic footprint of anthropogenic noise sources sighted and acoustically recorded during concurrent visual and acoustic effort.

**Methods:** This study will analyze passive acoustic monitoring data and provide acoustic detections for each species/noise source in 5-hour time bins per mooring site. Time bins with detections (detection positive time bins), will be extracted from these results to estimate “detection positive time density” at each grid cell covered by the acoustic mooring’s detection range on a bi-weekly or monthly time scale. Visual sightings will be used to derive spatially-explicit estimates of each species/noise source “detection positive time density” on the same bi-weekly or monthly time scale used for the acoustic analysis. Geospatial statistical methods will be used to map the combined acoustic and visual marine mammal presence density for each time period.

Averaged ambient noise measurements will be computed to identify noise peaks. Spatial and temporal distribution of noise peaks will be compared to anthropogenic noise sources sighted during the aerial surveys. Vessel based short-term visual sightings and acoustic detections (via 24/7 sonobuoy deployments) will be incorporated as practicable into the noise analysis. When noise peaks line up with visual detections of noise sources based on location and temporal occurrence, acoustic footprints will be calculated (*i.e.*, radial distance to source corresponding to dB exceedance from average ambient noise level).

This proposed study would provide a framework for further data sets to be incorporated into the integrative analysis. Acoustic data or visual effort from the private sector (*e.g.*, mitigation plans, sound source verification studies, *etc.*) could be considered to expand the spatiotemporal coverage of this proposed integrative approach.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Beaufort Sea, Chukchi Sea

**Administered By:** Alaska OCS Region

**Title:** The View from Above: Continued Life-History Analyses of Bowhead Whales via Aerial Photo-Identification

**BOEM Information Need(s) to be Addressed:** BOEM needs information regarding important life history parameters of bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort Seas (BCBS) stock. Results from this study will support evaluations of the potential effects of oil and gas exploration, development and production activities on marine mammals as required under NEPA, the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). Data from this project will inform NEPA assessments for lease sales, EPs, and DPPs in the Chukchi and Beaufort Seas.

**Approx. Cost:** (in thousands) \$200

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** The bowhead BCBS population is one of the most important subsistence animals for many Native communities in northern and western Alaska. The harvest is managed by the International Whaling Commission (IWC) and basic biological data are essential for setting safe harvest levels. After being severely depleted by commercial whaling in the 1800s, research indicates that this population is recovering well; however, that cumulative effects of arctic shipping, commercial fishing, climate change, and oil and gas exploration could slow population recovery. Since the mid-1970s, monitoring of the BCBS population has been primarily through ice-based surveys conducted near Barrow, Alaska. A future on-ice census may be attempted, but due to deteriorating ice conditions (related to climate warming and sea ice loss), it may be necessary to transition to aerial surveys and photo-identification mark-recapture studies for monitoring the BCBS stock. The proposed project offers a unique opportunity to match more than 30 years of aerial photos in the master catalog. This information will be valuable for (a) estimating population size and trends via capture-recapture modeling, (b) estimating survival rates far more accurately and precisely; (c) determining calving intervals; (d) evaluating changes in fishing-gear entanglements and ship strikes.

The bowhead photo-id program, which is currently managed by NOAA's Marine Mammal Laboratory (NOAA-MML), the North Slope Borough (NSB), and LgL Canada, was started by NOAA-MML, Cascadia, and LGL, Ltd. in the early 1980s to begin addressing questions about bowhead life history, of which very little was known. The urgency was in part from the IWC moratorium on the subsistence hunt of bowhead whales by Alaska Natives. The program grew in sophistication and was conducted intensively through the 1980s and early 1990s to investigate important life history questions, in particular calf production rates, as well as questions regarding the effects of oil and gas activities on bowhead whales. While few surveys were done from 1992 to

2002, two remarkably successful aerial photogrammetric surveys were conducted in 2003 and 2004, funded by NSB with logistical support by LGL. In 2011, aerial photographic surveys for bowhead whales were conducted near Point Barrow, and a mark-recapture analysis is underway using the 2011 data. Further, photographs are still being collected during NMFS aerial surveys so the database spans from 1982–2015.

The collection includes at least 21,000 images of more than 13,000 individuals. However, the photo matching effort is sporadic and incomplete, although each additional inter-year re-identification provides essential information for the basic biology, conservation, and management of bowhead whales. Between the collections maintained at NOAA-MML in Seattle, Washington and at LGL in King City, Ontario, there are about 5500 (naturally) marked bowhead whales in the photographically captured population (1985 –2011), representing roughly 30% of the individuals in this stock.

**Objectives:** The goal of this study is to assist with continuation of the NSB/NOAA-MML/LGL bowhead whale photo-identification program to:

- Evaluate the population size and trend of the BCBS bowhead whale stock.
- Refine existing estimates of individual growth rates, survival rates, calving intervals, scar accumulation, and estimated ages.
- Analyze anthropogenic injuries to bowhead whales from fisheries gear entanglement and killer whale (scarring) injuries
- Test working hypotheses about bowhead life history parameters using photo-id, including: high individual survival rates, extremely high longevity, delayed age at maturity (ca 25 years), and 3-4 year calving intervals.

**Methods:** Standard protocols established by NOAA-MML will be used to complete inter-year matching of aerial photographs of bowhead whales primarily taken during their spring migration past Point Barrow for the years 1985 to 2011. These aerial photographs will be used to identify individual whales. Proven scientific methods will be used for analyses such as mark-recapture abundance estimation, estimation of survival rates, calving intervals, and measurement of individual growth rates.

**Revised Date:** March 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western Gulf of Mexico, Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Gulf of Mexico Air Quality Study: Pollutant Transport, Atmospheric Dynamics, Monitoring and Modeling

**BOEM Information Need(s) to be addressed:** BOEM has urgent needs to attend in air quality including: 1). Update the existing air quality regulations according to the new federal regulations; 2). Evaluate the impact of emissions sources, cumulative analysis of offshore activities, and future scenario emissions in the air quality sections of NEPA documents in agreement with the new standards; 3). Implement a dispersion modeling guideline to be followed by operators when exemption levels onshore are surpassed; and 4). Determine the applicability of short-range (distance lesser than 50 km from emission source) preferred models in the revised federal rules under practical applications for BOEM. These achievements will support BOEM missions and facilitate air quality managing and decision making.

**Approx. Cost:** (in thousands) \$6,500      **Period of Performance:** FY 2017–2022

### **Description:**

**Background:** In 2015, the U.S. Environmental Protection Agency (EPA) reviewed the rules that apply to Federal air quality management programs that conduct air quality modeling assessments, strengthened the National Ambient Air Quality Standards (NAAQS) for ozone, and proposed rules to reduce greenhouse gas (GHG) emissions in the U.S. necessary to address climate change. The revised EPA ozone standard will impact the designation of non-attainment areas in 2017 and, in particular, will impact areas in Texas (Montgomery, Harris, Galveston, and Brazoria counties), Louisiana (Pointe Coupee, East Baton Rouge, Livingston, and St. Tammany), and Mississippi (Jackson County). These issues will need to be addressed by BOEM in the near future. Since BOEM is required by the OCSLA to assure compliance with NAAQS, and follows EPA modeling guidance in post-lease and pre-lease activities, changes to modeling guidance must be adapted accordingly by the agency to maintain regulatory consistency between the OCSLA air regulations and Clean Air Act (CAA). The EPA revisions included enhancements to the formulation and application of the EPA's AERMOD model for short-range dispersion of inert pollutants from terrestrial sources. However, AERMOD is rarely used over oceanic environments, and it cannot predict ozone, secondary particulate matter at 2.5 microns, and other pollutants formed through atmospheric chemical reactions. For over-water modeling, the revised EPA modeling guidance continues to recommend the outdated near-field Offshore and Coastal Dispersion Model (OCD), which was developed in 1985 and has not been updated since 2000. While EPA modeling guidance refers to AERMOD and OCD as preferred models (for over land and offshore sources, respectively), such models are inadequate to properly assess ozone and fine particulate impacts from offshore sources because they do not account for complex atmospheric chemical reactions involved in the formation of these pollutants and their precursors. EPA's NAAQS criteria pollutants include carbon

monoxide, nitrogen dioxide, ozone, particulate matter at 2.5 and 10 microns, sulfur dioxide, and lead.

Currently in the GOMR (westward of 87° 30' W longitude, consisting of WPA and most of the CPA), there is not adequate over-water data (continuous long-term surface observations and atmospheric profile data) and the modeling tools are incomplete to accurately predict offshore emission dispersion.

The present study is built upon previous BOEM experience. Combined field and modeling surveys have not been performed since the early 1990s, when MMS accomplished the Gulf of Mexico Air Quality Study (GMAQS) (OCS Study MMS 95-0038), which assessed the impact of oil and gas offshore emission sources on ozone concentrations in non-attainment areas in Texas and Louisiana. GMAQS defined directions to be addressed by BOEM in years to come, including the Gulfwide Emission Inventories (GEIs) in 2000, 2005, 2008, 2011, 2014 (in progress) and studies in meteorology and boundary layer. Since 2005, GEIs have reported criteria pollutants except ozone and lead, and GHG (carbon dioxide, methane and nitrous oxide). BOEM has dedicated about \$13 million for air quality and meteorological studies. An ongoing project, *Air Quality Modeling in the Gulf of Mexico Region* (GM-14-01), is assessing the impact of offshore emissions using AERMOD and OCD, and photochemical models; however, observations and model evaluation are excluded in this effort. More appropriate for BOEM's mission are the photochemical models (e.g., Community Multiscale Air Quality [CMAQ]) and the Weather Research and Forecasting couple with Chemistry (WRF Chem), which predict chemical transformations and transport of pollutants for long-range distances (greater than 50 km from emission source). EPA refers to alternative models to individual cases where preferred models are not applicable or not available. Combining modeling and observational data would be required to determine confidence levels of model results and obtain realistic data to evaluate environmental impacts and cumulative effects, air quality managing, and decision making.

#### Objectives:

1. Perform a comparative evaluation of preferred and alternative models to improve air quality for managing and decision making in BOEM.
2. Advance current understanding of coastal transitions and transformations of NAAQS criteria pollutants, formation of ozone and its precursors, assessing trends in GHG emissions, and appropriately address effects of regional climate change.

Methods: An interagency collaboration including EPA is envisioned to perform rigorous temporal and spatial statistical modeling data analysis, and a partnership with the National Oceanic and Atmospheric Administration (NOAA), because BOEM alone does not have the technology, network monitoring, and staffing to collect high resolution data. The Texas Commission on Environmental Quality (TCEQ), with extensive experience in similar large projects, is also willing to participate. This is a 5-year study with long-term and short-term sampling. The long-term consists of three consecutive years of hourly observations at fixed stations placed in onshore, coastal, and oceanic

areas. Measurements include NAAQS criteria pollutants (excluding lead), ozone precursors, and GHG included in GEIs. Instrument deployment at existing platforms is part of this effort. To this end, conversations with the American Petroleum Institute (API) and the Offshore Operators Committee (OOC) are in progress. The short-term consists of sampling summer time (when peaks of ozone occurs) in two consecutive years using aircraft, remote sensing (satellite and Light Detection And Ranging [LiDAR]), and surface measurements (research vessel) to monitor criteria pollutants, ozone and precursors, their transport, transformation, and transition from offshore to coastal areas. Atmospheric characterization and rigorous model evaluation and diagnostics (particularly for ozone and precursors) are key components of the short term scrutiny. NOAA will be heavily involved in the short-term sampling since their extensive experience in large field campaigns (e.g., 2000 and 2006 Texas air quality studies, and 2010 *Deepwater Horizon* Oil Spill). The last two years will be dedicated to statistical data analysis, model evaluation and report, and publishing.

**Revised Date:** January 27, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 Resources of the Gulf of Mexico

**BOEM Information Need(s) to be Addressed:** NEPA requires that BOEM estimate cumulative environmental impacts potentially resulting from OCS oil and gas development and other human activities. However, estimating the effect of cumulative impacts on resources is one of the most difficult aspects to developing a quality NEPA document, especially in environments like the GOM where activities in one location could indirectly result in significant impacts to resources in other locations. The proposed study would provide a benchmark of cumulative impacts to GOM resources, estimate resource vulnerability to human activities, and enhance BOEM’s ability to analyze the OCS oil and gas contribution to cumulative impacts.

**Approx. Cost:** (in thousands) \$150

**Period of Performance:** FY 2017–2019

### **Description:**

Background: GOM resources are influenced by a wide range of human activities occurring in many combinations and with varying frequency, duration, and intensity. Long-term, intensive exploitation of the region’s coastal and marine resources make determination of baseline conditions difficult and quantitative baseline descriptions are incomplete for most resources. An alternative to the current approach would be the determination of benchmark conditions, with respect to a NEPA-compatible reference timeframe. Cumulative impact levels could be quantified for a representative subset of key resources and resource vulnerability could be assessed, using methods similar to those described by Micheli *et al.*, (2013) and Teck, *et al.*, (2010), respectively. Briefly, spatial datasets for key impact producing factors were transformed and rescaled to accommodate regional comparisons. Cumulative impacts to selected resources were calculated from these data. Experts were surveyed to estimate resource-specific vulnerabilities and weight the calculated impacts. Expert judgement has been found to be an acceptable standard in past NEPA analyses of ecosystems deemed too large or complex for comprehensive analysis. Similar studies have used regional and global expert opinion where comprehensive analyses would be too costly and time-consuming. Particular resources and/or combinations of stressors for which detailed analysis is justified may also be identified through this process.

The resulting benchmark conditions and vulnerability scores would serve as a basis for estimating the contribution of various impact producing factors in future cumulative impact analyses. Additionally, results for the GOM could be compared to similar surveys and analyses (Halpern *et al.*, 2008; Claudet and Fraschetti, 2010; Micheli *et al.*, 2013; and Hunsicker *et al.*, 2015). Comparisons with regions exposed to similar anthropogenic activities and possessing comparable resources may provide readers with

the necessary perspective to place BOEM's detailed regional environmental analyses into a global context. An understanding of the condition of GOM resources relative to other regions with similar stressors could be useful to management for outreach and highlighting the success of BOEM program management.

**Objectives:** The objectives are to assess cumulative impacts to biological, physical, and cultural resources, establish benchmark conditions that quantify cumulative impacts, and estimate resource vulnerability for the purpose of focusing NEPA cumulative impact analyses in the GOM.

**Methods:** Following the lead of several other studies that have addressed similar issues, experts could be surveyed to elicit key resources and impact drivers for analysis. Representative resources (*e.g.*, habitats, air quality, and cultural resources) and impact producing factors would be selected based on BOEM priorities. NEPA-compatible time scales would be used to determine the periods of activity to be assessed for cumulative impacts. Spatial data for the selected resources and stressors affecting those resources would be compiled from available datasets. Data would be converted as needed to accommodate regional analyses. Global and regional experts on the selected resources would be surveyed to estimate resource vulnerability to individual and combined stressors, and to obtain rankings of current status and exposure relative to other regions. Cumulative impact levels for regional resources would be assessed. Data layers for the resources, cumulative impacts, and drivers would be produced and made available for use.

### **References:**

- Claudett, J., and S. Fraschetti. 2010. Human-driven impacts on marine habitats: A regional meta-analysis in the Mediterranean Sea. *Biological Conservation*, 143:2195-2206.
- Halpern, B., S. Walbridge, K.A. Selkoe, C.V. Kappel, F. Micheli, C. D'Agrosa, J.F. Bruno, K.S. Casey, C. Ebert, H.E. Fox, R. Fujita, D. Heinemann, H.S. Lenihan, E.M.P. Madin, M.T. Perry, E.R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A global map of human impact on marine ecosystems. *Science*, 319:948-952.
- Hunsicker, M.E., C.V. Kappel, K.A. Selkoe, B.S. Halpern, C. Scarborough, L. Mease, and A. Amrhein. 2015. Characterizing driver-response relationships in marine pelagic ecosystems for improved ocean management. *Ecological Applications* (In Press).
- Micheli, F., B.S. Halpern, S. Walbridge, S. Ciriaco, F. Ferretti, S. Fraschetti, R. Lewison, L. Nykjaer, and A. Rosenberg. 2013. Cumulative human impacts on Mediterranean and Black Sea marine ecosystems: Assessing current pressures and opportunities. *PLoS ONE* 8(12):e79889.
- Teck, S.J., B.S. Halpern, C.V. Kappel, F. Micheli, K.A. Selkoe, C.M. Crain, R. Martone, C. Shearer, J. Arvai, B. Fischhoff, G. Murray, R. Nelslo, and R. Cooke. 2010. Using Expert judgement to estimate marine ecosystem vulnerability in the California Current. *Ecological Applications* 20(5):1402-1416.

**Revised Date:** January 19, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** GOM Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology & Archaeology Project II (GOM-SCHEMA II)

**BOEM Information Need(s) to be Addressed:** BOEM 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)* oil 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 other research consortia initiated after the spill did not evaluate impacts to submerged cultural resources. Information acquired by the study will allow BOEM to more adequately consider the 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 conduct long-term monitoring of these archaeologically 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. In FY 2013, BOEM funded a three-year study with Federal, academic, and private sector partners to examine micro- and macroscale impacts of the 2010 *DWH* oil spill on deepwater shipwrecks and their resident microbiota in the GOM. The study, renamed “GOM Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology, and Archaeology (GOM-SCHEMA),” collected samples in 2014 to inform microbial ecological analyses of several deepwater shipwrecks in spill-impacted vs. unimpacted areas. Study sites included wooden-hulled and metal-hulled shipwrecks for comparison. The study found evidence of a significant sedimentation event after the spill, consistent with “marine oiled snow,” which modified the local environment at sites nearest the spill origin. Microbiome composition showed reduced microbial diversity and community functionality in spill-impacted areas as compared to unimpacted areas, indicating effects from the spill persisted four years later. To inform on the effects of local contamination and bio-fouling recruitment patterns (biofilms) on shipwrecks, *in situ* monitoring platforms containing wood and steel coupons were deployed as proxies to avoid damaging the wrecks by sampling hull materials. Complementary laboratory experiments performed in water tanks on steel coupons after biofilm recruitment demonstrated that exposure to oil and oil/dispersant altered microbial community structure and function and enhanced metal corrosion as compared to coupons left untreated (controls). In addition, 3-D laser, 3-D sonar, and high-resolution multibeam bathymetry digitally recorded each shipwreck’s condition in 2013/2014 to allow

archaeological analysis of macroscale changes since the sites were documented prior to *DWH*. The GOM-SCHEMA II project intends to repeat GOM-SCHEMA's data collection, sampling, and experimental approaches eight years after the spill to provide time-series datasets for monitoring ecosystem recovery and to document variability in site condition and stability over time.

Objectives:

- 1) To determine if impacts to shipwreck microbiomes from the 2010 spill and use of chemical dispersants persist after eight years (four years after initial sampling);
- 2) To determine if these impacts have negatively affected shipwreck preservation (enhanced wood degradation/metal corrosion) in spill-impacted areas as compared to sites in unimpacted areas; and
- 3) To document the shipwrecks' current 2018 state of preservation to assess and quantify any transgressive changes since 2014 and prior to the *DWH* spill.

Methods:

- 1) Conduct a literature review to assess the current state of knowledge pertaining to impacts from the *DWH* spill and dispersants on benthic biota;
- 2) Repeat sampling, 3-D optical/acoustic data collection, *in situ* and *ex situ* experiments, and analysis efforts from GOM-SCHEMA I at the shipwrecks to assess their current (2018) physical, chemical, and ecological condition and their local environment within spill-impacted and unimpacted areas;
- 3) Assess the biota associated with the sites and evaluate temporal changes as well as extrapolate those related to the *DWH* spill;
- 4) Document the shipwrecks' current state of preservation and local site formation processes; and
- 5) Incorporate a public outreach/education component (*e.g.*, social media, blogging from the field, participation in STEM programs, *etc.*) to engage the next generation of scientists in this research.

BOEM will again seek to assemble a broad partnership among Federal, academic, and private entities with cost-sharing where possible to help reduce the costs to BOEM. In-kind support and cost-share for field cruises is anticipated from current study partners/collaborators at the U.S. Naval Research Laboratory and Office of Naval Research. High-resolution digital imagery (video, photo, 3-D laser/sonar, multibeam, *etc.*) and other data collection and sampling efforts are dependent upon the availability of an appropriate research vessel, Remotely Operated Vehicle (ROV), and potentially an Autonomous Underwater Vehicle (AUV).

**Revised Date:** March 24, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** The Fiscal Impacts of the Gulf of Mexico OCS Industry

**BOEM Information Need(s) to be Addressed:** The GOM offshore oil and gas industry contributes in various ways to the revenues and spending patterns of federal, state, and local governments. In particular, offshore oil and gas activities support direct government revenue streams, as well as indirect revenue streams arising from the taxation of economic activities. However, BOEM has incomplete information regarding these effects, partially due to the complexities of estimating fiscal impacts. This study would entail a detailed analysis of the various paths through which the GOM OCS industry supports government revenues and spending. The information obtained from this study would support analyses within regional EISs, Headquarters EISs, and analyses associated with 5-Year Program decision documents.

**Approx. Cost:** (in thousands) \$400

**Period of Performance:** FY 2017–2020

### **Description:**

**Background:** The GOM offshore oil and gas industry contributes in various ways to the revenues and spending patterns of federal, state and local governments. Most directly, offshore oil and gas operators pay bonus bids on lease sales, rental payments prior to production, and royalties on production. Historically, most of these revenues have accrued to the federal government, and have supported federal spending on various programs. Some of these direct revenues are distributed to states and local governments, such as through the 8(g) program (for leases within 3 miles of state waters) and through the Gulf of Mexico Energy Security Act (GOMESA) of 2006 (which allows for revenue sharing for certain OCS leases). In FY 2017, GOMESA revenue sharing will expand to a much larger set of offshore activities; see BOEM (2016) for more information. This will increase the direct fiscal impacts of offshore oil and gas activities on GOM states and localities.

In addition to direct revenue streams, offshore oil and gas activities indirectly support various types of government revenues and spending. For example, firms in the OCS industry pay corporate taxes and taxes on their spending. Workers in the OCS industry pay income taxes, sales taxes, dividend taxes, and property taxes. These revenue streams support various types of federal, state and local spending. However, it is difficult to estimate these impacts because of the differing structures of the revenue and spending patterns of state and local governments. In addition, an analysis of the indirect fiscal impacts of the OCS industry requires estimation of the portion of certain revenue streams that arise from OCS activities. BOEM has historically described these effects qualitatively or through applying some simplifying assumptions. The purpose of this study is to more precisely estimate these complex fiscal effects.

### Objectives:

- 1) To assess the historical fiscal impacts of the GOM offshore oil and gas industry.
- 2) To forecast the future fiscal impacts of the GOM offshore oil and gas industry.

Methods: The study will entail conducting background research regarding the current and historical structures of federal, state, and local revenues and spending. The study will then use both bottom-up and top-down approaches to estimate the historical and future direct and indirect fiscal impacts of the GOM OCS industry. A bottom-up approach entails estimating individual components of OCS industry activities, and then tracing through the various steps towards the associated fiscal impacts. For example, for drilling activities, a bottom up approach would estimate the amount of (and spending on) drilling activities, then estimate where the drilling firms and employees are located, and then estimate the indirect fiscal impacts based on knowledge of each geographical area's fiscal system. A top-down approach entails using statistical techniques to infer relationships between historical OCS activities and fiscal impacts. For example, regression analysis can be used to estimate the correlations between OCS activities and fiscal impacts, while controlling for various other factors that change over time. The results of these approaches will be compared and contrasted. This project will then develop a model that translates estimates of OCS activities into fiscal impacts to federal, state, and local revenues. This study will develop estimates of the fiscal impacts to all GOM states, although there will likely be limits regarding the extent to which local level impacts can be estimated. This issue will be dealt with by applying certain assumptions, by aggregating localities in an appropriate manner, or by focusing on a subset of local governments. Since indirect fiscal impacts are dependent upon estimates of the amounts and locations of industry spending, the fiscal model will likely build off of some BOEM internal models of these effects. Finally, this project will lead to a study report that synthesizes the findings of the various methodologies.

### **References:**

Bureau of Ocean Energy Management (BOEM). 2016. Gulf of Mexico Energy Security Act Information. Internet website: <http://www.boem.gov/Revenue-Sharing/>.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 Council on Environmental Quality's (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 which 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. The 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 (GCCF) lacked documentation. While some commercial fishers were eventually paid based on ethnicity and need, 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 (MSFCMA). 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.

**Methods:** Little is written about Gulf subsistence. Popular literature provides the most information although one academic work 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 synthesize selected literature on subsistence elsewhere in the world.

Generally, social science literature describes subsistence harvest systems in the United States as organized by non-market principles of kin and community although some Alaska Native subsistence derives from commercial salmon harvests. 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, BOEM's 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. Literature-based insights and comparisons from non-Gulf systems will also be used to enrich the findings of this study.

**Revised Date:** March 24, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** Renewable Energy Potential Assessment for the Gulf of Mexico Outer Continental Shelf – Wind Energy Feasibility Study

**BOEM Information Need(s) to be Addressed:** BOEM needs information to assess alternative energy feasibility for the Gulf of Mexico OCS to inform long-term understanding of potential development activities within the Bureau's purview under the Energy Policy Act of 2005 (EPAAct). These regulations provide a framework for issuing leases, easements and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas. This study will help inform BOEM's strategic long-term plans related to possible OCS alternative-leasing activities in the GOM.

**Approx. Cost:** (in thousands) \$200

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** In keeping with the President's Climate Action Plan announced in 2013, there is impetus across federal agencies to develop projects which result in lowered carbon emissions and greenhouse gas production, as related to climate and human health goals. Renewable energy projects are underway in Atlantic and Pacific OCS waters, but the concept has not been thoroughly explored in the Gulf of Mexico. Available National Renewable Energy Laboratory (NREL) maps (<http://www.nrel.gov/gis/wind.html>) demonstrate that there is sufficient wind energy potential in the central and western Gulf to support further analysis of regional offshore wind resources. There are significant onshore design and fabrication facilities and offshore infrastructure in the Gulf that have been developed in support of oil and gas and which can be utilized by renewable energy projects. For example, two Louisiana firms with roots in the oil and gas industry played an important role recently in the creation and construction of the nation's first offshore wind farm, the Deepwater Wind Block Island Project off New Jersey. The steel foundations for the wind farms turbines were designed by a company in Mandeville, Louisiana and were built at a fabrication facility in Houma, Louisiana.

**Objectives:** The goal of this study is to perform a feasibility analysis for wind energy development on the Gulf of Mexico OCS to inform the Bureau's strategic planning.

**Methods:** An in-depth feasibility assessment will be performed for wind energy potential in the GOM, providing a comprehensive analysis ranging from resource potential through economics/jobs and environmental implications. The study will begin with a wind-resource assessment using a geospatial distribution analysis of wind potential/velocities. Bottom conditions and bathymetry overlays will be considered as

they relate to constraints on technology placement. Technology considerations will be assessed related to advances in available technologies, those best suited to the Gulf (e.g., withstanding hurricane-force winds) and the depth ranges of interest, and uses of existing offshore infrastructure. Regarding the latter, consideration will be given to the earlier study, *Assessment of Opportunities for Alternative Uses of Hydrocarbon Infrastructure in the Gulf of Mexico* (OCS Study BOEMRE 2011-028). Economics play a critical role when assessing the feasibility of offshore wind projects. Market-side parameters will be considered including grid connection points, end-use options, economic conditions, and cost of energy. This analysis will identify the major cost variables comprising a wind project investment and will estimate the cost of energy derived from hypothetical offshore wind projects in the GOM. The cost of energy is defined as the total expenses required to build and operate a project over its effective lifetime divided by the total energy generated by the project (i.e., dollars per kWh). Consideration will be given to the ability of the existing regional infrastructure (manufacturing, vessels, etc.) to participate in the supply chain. Finally, perspectives will also be provided on the environmental implications of wind turbines, such as related to decreased carbon emissions and considerations for avian flyways.

**Revised Date:** March 24, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western Gulf of Mexico, Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Multibeam Survey of Small Topographic Features to Determine Efficacy of Current “No Activity Zones”

**BOEM Information Need(s) to be Addressed:** Since the 1970–1980s there has not been an update or an evaluation of the efficacy of the “No Activity Zones” (NAZ) associated with topographic features in the Gulf of Mexico. The NAZs distance bottom-disturbing activities away from potentially sensitive habitats. However, the NAZs boundaries are defined by bathymetric contours derived from some of the earliest survey work. Technological advances in survey techniques and GIS mapping, combined with new data about ecology of topographic features, warrants the need to re-map these features so BOEM can determine if these areas are functioning as intended. Because of NOAA’s interests of these features, this project is a collaborative effort by BOEM and the Flower Garden Banks National Marine Sanctuary. This study specifically addresses a NEPA need and a requirement of the OCS Lands Act to collect data with the specific purpose of the periodic evaluation of BOEM’s mitigations with respect to bottom-disturbing activities.

**Approx. Cost:** (in thousands) \$306

**Period of Performance:** FY 2017–2018

### **Description:**

**Background:** Topographic features in the Gulf of Mexico are geologic formations (*e.g.*, diapirs) that extend up into the water column from the seafloor. These features provide habitat for coral and sponge colonization and support large communities of fish and invertebrates. The features and associated communities were deemed critical to fisheries and ecology of the Gulf, and were among the first habitats to be protected from OCS related bottom-disturbing activities.

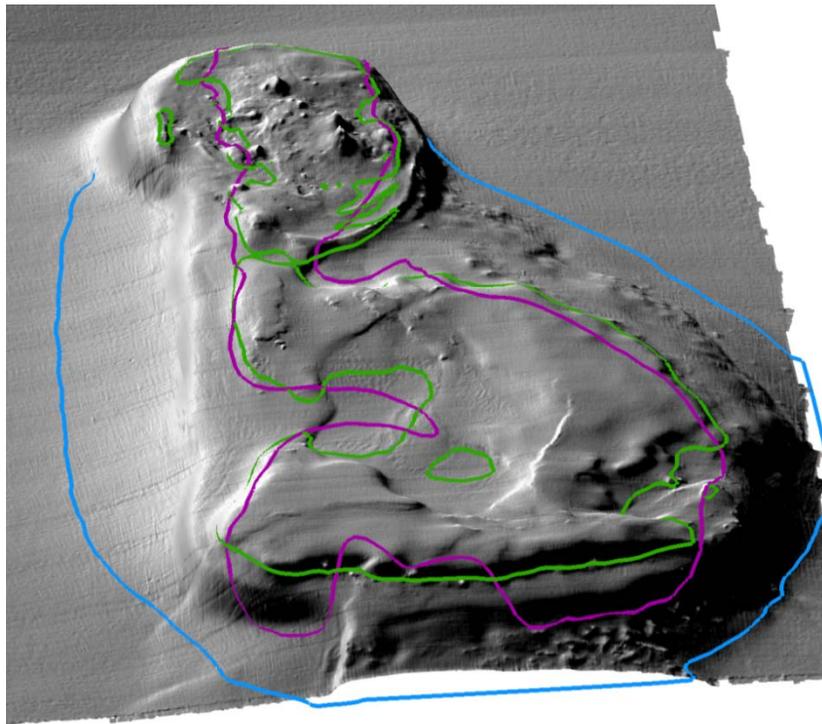
Originally, BOEM implemented the NAZs as a NEPA mitigation, defining the boundaries a specific isobaths that encompassed the highest point of each feature. The highest points of the features were designated to protect areas identified by stakeholders as being important for minimizing potential impact to the ecology or stakeholder interests. The surveys used to map these features and identify important areas were cutting edge at the time, although rudimentary compared to the technology available today. Multibeam surveying and GIS mapping has become commonly used resources for scientists and OCS operators. With this technology, information that was once limited in use is now routine on all vessels and platforms working the OCS. In addition, our understanding of the ecology of topographic features has expanded (*e.g.*, Fredericq *et al.*, 2014 in *Cryptogamie*, 35:77-98). Resulting advances have highlighted the importance of the areas of the features not covered by the NAZs.

This is a collaborative project between BOEM and NOAA to map these features with NOAA providing the R/V *Manta* at a discounted rate for survey days and providing the

vessel for calibration cruises. NOAA's cooperation is due to their need to explore four unsurveyed topographic features and to identify habitats that may require additional protections. Evaluation of the NAZs began in 2014; however, sites identified for this project are features where data was not of sufficient quality to outline the feature with a high degree of confidence. Of the 37 identified topographic features, 16 banks need additional surveys. Revision of the NAZs includes mapping using 3-D tools to better visualize aspects of the features not available through 2-D mapping (Figure 1). Survey of the additional four features identified by NOAA will also allow BOEM to determine if these features need additional protections from bottom-disturbing activities.

**Objectives:** The objective of this study is to map 20 topographic features in the GOM using a multibeam sonar system and present those data in a manner where they can be used by BOEM and NOAA to re-evaluate and modify stipulation and mitigation (e.g., NAZs) policies used to manage environmental resources.

**Methods:** Through an Interagency Agreement with NOAA, NOAA will conduct the survey over a period of 20 days at sea, broken into 4 location-based cruises. Upon completion of the surveys, NOAA will be responsible for post-processing of data and provide the data to BOEM in a manner that would be acceptable and usable by BOEM GIS personnel. Once accepted by BOEM, the data would be incorporated into the on-going project for the re-evaluation of the efficacy of the NAZs.



**Figure 1.** Example of multibeam survey product for a topographic feature. Red line represents NAZ boundaries based on historic bathymetric data. Green line represents boundaries based on multibeam survey. Blue line represents proposed boundary changes to NAZ.

**References:**

Fredericq, S., N. Arakaki, O. Camacho, D. Gabriel, D. Krayesky, S. Self-Krayesky, G. Rees, J. Richards, T. Sauvage, D. Venera-Ponton, and W.E. Schmidt. 2014. A dynamic approach to the study of Rhodoliths: A case study for the northwestern Gulf of Mexico. *Cryptogamie* 35:77-98.

**Revised Date:** March 15, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

Study Area(s): Central Gulf of Mexico, Western Gulf of Mexico

Administered By: Gulf of Mexico OCS Region

Title: Gulf SERPENT for Deepwater Biological Observing:  
Synthesis of Historical Datasets and Continued Sampling

**BOEM Information Need(s) to be Addressed:** BOEM will obtain information that will help fill a large data gap for mid-water and water bottom deep-sea animals in the GOM. The ongoing SERPENT program provides information on species presence, seasonality, spatial and vertical occurrence, and behavior that continues to expand an understanding of water-column and benthic/demersal biology of the deep Gulf. The resulting data will be valuable for NEPA documents, including lease sale EISs. SERPENT data have not yet been published and have not yet been incorporated into NEPA documents. In addition to new data collection, this study will provide a historical synthesis of deepwater ecological observations that will contribute to BOEM's long-term monitoring assets and the ability to determine potential trends in marine ecosystem health due to impacts from oil and gas activities.

**Approx. Cost:** (in thousands) \$325

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** The pelagic waters seaward of the 200 m isobath remain a poorly studied region of the oceans in general and the GOM in particular. The principal obstacle to furthering biological oceanographic research in the deepwater regions is one of access to capable ships and ROV systems. However, deepwater drilling and production operations usually employ industrial ROV systems. These commercially produced ROV's are sophisticated vehicles capable of operating to depths of over 1000 m while equipped with manipulator arms, cameras, lights and other sensors (*e.g.*, temperature, pressure, current velocity). Thus, deepwater energy exploration provides the potential for extended access to poorly studied regions of the ocean combined with appropriate ROV systems for deep sea exploration.

The concept of using some of the operational standby time of industrial ROV's for scientific research was the genesis of the SERPENT project (Scientific Environmental ROV Partnership using Existing Industrial Technology) (<http://www.serpentproject.com/>) based at the National Oceanographic Institute in Southampton, UK. SERPENT works to bring scientists and industrial partners together to explore the oceans with ROV's and other industrial technology. There are SERPENT Project partnerships in operation at almost all the major deepwater exploration and production centers around the world. Gulf SERPENT was initiated in 2006 with funding from NOAA. Since 2007 the project has been funded by BOEM (formerly MMS) with in-kind contributions based on the value of ROV time contributed by industry. A challenge in earlier Gulf SERPENT efforts has been that industry level of involvement has fluctuated because of matters related to access. This seems to be related to the depressed oil price and general increasing risk aversion of industry.

Nevertheless, Gulf SERPENT has achieved a level of deep-sea observation in the GOM, which would have been impossible using research ROVs available to the academic community.

**Objectives:** The overarching goals of this study are two-fold: 1) to continue existing Gulf SERPENT research in expanding a database of marine life from the mesopelagic and bathypelagic regions of the GOM, and 2) to develop long-term time series related to deepwater ecology based on a synthesis of ROV and ancillary datasets.

**Methods:** This is proposed as a three-year project with partnering funds based on the value of ROV time contributed by Industry to the project. The study will continue to use the survey methodologies that have been previously implemented for Gulf SERPENT. Surveys will include horizontal transects in the water-column, radial seafloor transects, and opportunistic observations. Gulf SERPENT personnel will continue to conduct site visits to train the ROV pilots on survey protocols and organisms of interest, including use of the new BP-funded “Pictorial Field Guide to Deep-Sea Organisms of the Gulf of Mexico” (Moretzsohn and Benfield, 2015). Once training is complete, the project will continue autonomously with the offshore ROV teams contributing data via hard-drives and other media containing observations recorded on digital video. The data will then be screened at LSU and separated into clips containing individual organisms. Each animal will be identified to the lowest taxonomic level possible and the date, time, depth, location, and other metadata will be stored in a database.

The longest historical records obtained from the Gulf SERPENT program will be identified and analyzed, along with ancillary data, to provide long-term time-series and indicators of deepwater ecological trends. At the very least, a time-series will be developed related to the presence of various taxa both in the water column and on the seafloor across a multi-year period at multiple locations. In addition to ROV data, ancillary data from acoustic Doppler current profilers (ADCPs) at the facilities and ocean color imagery will provide historical data related to zooplankton/micronekton abundance and chlorophyll *a* concentrations. A likely candidate for starting this long-term historical analysis is BP’s Thunderhorse facility, where Gulf SERPENT has operated since 2008, with ADCP and meteorological time series also collected at the facility during that time period.

### **References:**

Moretzsohn, Fabio, and Mark Benfield. 2015. *Pictorial Field Guide to Deep-Sea Organisms of the Gulf of Mexico*. Harte Research Institute, Texas A&M University-Corpus Christi, TX.

**Revised Date:** March 21, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** Support for Socioeconomic Impact Assessments of Offshore Energy Development in the Gulf of Mexico Region

**BOEM Information Need(s) to be Addressed:** This effort will provide timely and focused information and analysis in support of Gulf of Mexico Region (GOMR) EISs, EAs, and other decision documents. Specifically, critical information will be provided for ongoing scenario development and impact analyses of land-use, coastal infrastructure, economics, demographics and environmental justice. Over the last two decades, the GOMR offshore oil and gas industry has been changing rapidly, often in unanticipated directions such as the removal of the Oil Export Ban, development of new facilities to export oil and liquid natural gas, rapid changes in international business climate, business practices, industry reorganizations, mergers and outsourcing, advances in technology and control systems, and significant energy market shifts in response to in the customary and often volatile fluctuations in oil and gas prices. As a consequence, the onshore social and economic impacts of offshore energy development are also changing, intensifying the concerns of coastal states. The importance of this cooperative agreement to BOEM is that it provides reliable support for timely and substantive responses to rapidly changing facts “on the ground” and to the public concerns that they engender.

**Approx. Cost:** (in thousands) \$400

**Period of Performance:** FY 2017–2020

### **Description:**

**Background:** One aim of BOEM’s Coastal Marine Institute (CMI) program is to encourage the development of regional expertise on environmental and socioeconomic issues raised as a result of the OCS leasing program. Cooperative interactions among GOMR and Louisiana State University’s Center for Energy Studies (CES) staff have achieved this goal. Over the years, these interactions have nurtured, within CES, an increasing expertise on the operations and economics of the varied sectors of the offshore petroleum industry, and on their function as vectors for socioeconomic impacts. This expertise focuses on the industry (*e.g.*, its organization, economics, operations), changes within the industry (*e.g.*, in development strategies, labor demand, geographic distribution), and direct effects of the industry and its changes (*e.g.*, employment, traffic, landfill use).

The GOMR has come to rely on this expertise, which has proven to be resourceful in identifying emerging issues (within the industry and for the states) and in providing relevant information and thorough analyses in the short turnarounds often necessary in the context of a complex and rapidly changing industry. The cooperative relationship between BOEM and CES has proven invaluable to the Bureau, particularly when new

questions arise that must be quickly addressed during the assessment process. This study will continue this relationship and thus BOEM's timely access to critical insights, information and analyses.

**Objectives:** This study will allow BOEM to rapidly address issues that arise and require quick answers from the requisite experts when time constraints inherent in NEPA schedules do not allow for targeted study development and peer-reviewed research. Examples of several critical and important questions: 1) What ongoing new information can be quickly provided to allow timely and considered responses to rapidly arising public and state concerns regarding the onshore impacts of the OCS leasing program? 2) In the face of rapidly changing baseline conditions, how can BOEM best develop accurate economic and socioeconomic assessments of the industry's effects? 3) What organizational and operational changes within the offshore industry are significant to the assessment of its economic and socioeconomic effects?

**Methods:** For each task, the research design will be developed as a cooperative effort between BOEM and CES staff. Methods may include but are not limited to: literature reviews, data collection from publicly available sources, targeted interviews or guided conversations with industry officials, workshops, and statistical and econometric analyses. Tasks will not employ any method that would require OMB clearance under the Paperwork Reduction Act. Work products may include literature reviews, data from focused collection efforts, written analyses, short (2–5 page) focus papers, and study reports. Selected final products may be jointly authored by BOEM and CES staff.

This study will allow BOEM staff to work collaboratively with LSU experts to perform short-term, highly focused efforts as issues critical to impact assessments arise as well as longer-term projects. The identification of specific tasks to be addressed and resources to be allocated will be done as needed, and as a cooperative effort between BOEM and CES staff. Tasks will address the following topical areas:

**Industry dynamics:** the identification and evaluation of changes occurring within the industry that affect its long- and short-term planning, operations, labor demand, distribution, and/or activity levels and the identification and evaluation of their economic and socioeconomic consequences.

**Industry sector operations and dynamics:** the description of the characteristics and operations of specific industry sectors (*e.g.*, geotechnical services), the identification and evaluation of changes occurring within the specific sectors, and the identification and evaluation of their economic and socioeconomic consequences (*e.g.*, technologies, capitalization, purchases, labor demands, and geographic distribution).

**State- and local-level operations and dynamics:** the identification and evaluation of the social and economic consequences to communities, counties/parishes, county/parish aggregations; or states of the operations of (or changes in the operations of) the industry or specific sectors of the industry at the community, county/parish, or state level.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Interdisciplinary Research at the Site of Three 19<sup>th</sup> Century Shipwrecks

**BOEM Information Need(s) to be Addressed:** BOEM and BSEE are required under the National Historic Preservation Act (NHPA) (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 the 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 2017–2019

### **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 have 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. A hypothesis has developed that Monterrey A was a privateer and the other vessels its captured prizes. If this is proven true, it is a unique discovery in the history on marine archaeology with international significance.

**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 their relationship, if any, to one another. In other words, were the ships sailing in convoy? 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. This activity will be especially beneficial for the Department of Interior's youth engagement initiative. 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 to: A) 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) recover a limited number of temporally diagnostic artifacts for detailed analysis; C) recover a limited number of artifacts that will assist in placing the vessel in its cultural and historical context; D) recover and analyze experimental wood coupons deployed at Monterrey A in 2013; E) recover large diagnostic artifacts at Monterrey A such as a cannon and the ship's stove; and F) 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 on Monterrey B and C.

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 Ocean 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:** March 21, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western Gulf of Mexico, Central Gulf of Mexico, Eastern Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Forecasting Helicopter Operations and Utilization in the U.S. Gulf of Mexico

**BOEM Information Need(s) to be Addressed:** The Environmental Assessment Section of BOEM is tasked with developing and maintaining future projections of helicopter and service vessel operations in the Gulf of Mexico. A recently funded study modeling the logistic network of service vessels provided background information and a model for forecasting of service vessel trips by the oil and gas industry (Keiser, Narra and Pulsipher 2014); the proposed study would provide comparable information on helicopters and serve as source material for BOEM’s Environmental Impact Statements and planning and regulatory requirements. In addition, model development is essential to forecast oil and gas related helicopter trips which are used to estimate potential adverse impacts to environmental resources in both proposed action and cumulative scenarios and are relevant to air quality and noise related impact analyses. In addition to aiding biological impacts, this information is also relevant to socio-economic impacts including economic impacts of helicopter construction, service and labor markets from leases sales and offshore activity. Scenario development for each 5-Year Program begins around 2.5 years prior to the new program. In order for this study and the new model to be incorporated into the next five year program (2022–2027), completion is desired by 2019.

**Approx. Cost:** (in thousands) \$200

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** The offshore helicopter construction and operation market in the Gulf Coast is worth over \$3 billion per year (Eastern Research Group, Inc. 2011), employs around 4,000 people (Dismukes 2010), and transports more than 2 million people each year (Helicopter Safety Advisory Conference 2014). Helicopter usage in the GOM has been decreasing over the past several years, but it is unknown if this is due to a change in fleet (a shift to larger capacity helicopters), less demand, or some other cause. It is important for BOEM and other stakeholders to have a better understanding of dynamics of helicopter trip projections, the geographic distribution of services, employment and community effects of the helicopter industry since it is a major sector of the offshore industry where little quantitative information is known.

OCS oil and gas-related helicopter activities impact coastal communities, employment, port activity, air emissions, ambient noise, and related factors. Many OCS impacts do not lend themselves to reliable quantification, require major effort to describe or employ highly uncertain or speculative empirical models, but the helicopter transportation industry is an exception since it is directly amenable to observation and classification. It is desirable to quantify the offshore sectors where quantification is possible, not only to

provide a roadmap of what is possible in socio-economic studies, but to make this information more broadly available to assist in planning and regulatory activity, to inform the public regarding OCS benefits, and to provide information to BOEM on difficult-to-describe sectors.

Eleven companies provide air transportation services to the offshore GOM (Eastern Research Group, Inc. 2011). All firms are domestic. The three public firms (Seacor Holdings, Inc., The Bristow Group, and PHI) are substantially larger than the private companies, a pattern seen throughout the oilfield services industries. These three public companies account for nearly 80 percent of the available commercial aircraft in the GOM (Dismukes 2010). However, we do not have a good understanding of what percentage of their service is provided to the oil and gas industry and what the function of the remaining 20% of the available commercial aircraft is in relation to the oil and gas industry.

Objectives:

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

Methods: (1) Develop an extensive background on helicopter construction, service and labor markets including how the industry operates, who are the main players, the size of the labor force, its geographic distribution along the Gulf Coast, and where and how many helicopters have been built in recent years. Additionally, major flyways should be used to locate areas at higher risk to noise or air pollution from helicopters. (2) Estimate the utilization of the helicopter service by the oil and gas industry and compare to the OSV service market. (3) Describe the factors influencing demand in operation and the service and construction markets and the regulatory factors that influence construction demand, including policy responses to the Deepwater Horizon oil spill and BOEM leasing decisions. (4) Prepare a model to forecast helicopter operation (trips) by the oil and gas industry based on current activity and how factors (such as distance from shore, depth of water, size of platform, production of oil/gas, timing of activities such as drilling, operation, decommissioning) may affect helicopter operation (trips). (5) If possible, obtain information regarding the cost sub-components of helicopter construction and operations, and identify the appropriate IMPLAN sectors for these costs. The study should determine the factors that affect the demand for services, how helicopter usage is impacted by the oil and gas industry and market conditions, and estimate the annual average revenue and employment trends in the region and their future outlook and what portion of this is dominated by the oil and gas industry.

The following sources of information could be used in this study: company annual reports and trade publications, data from the Helicopter Safety Advisory Commission,

helicopter tracking systems such as FlightAware, or market data. It is essential that the model output an estimation of the total number of helicopter trips required based on production scenarios developed within BOEM and consist of an activity matrix, a utilization matrix, and an allocation matrix. Methods for developing a model to forecast helicopter trips should be similar to the Kaiser *et al.*, (2014) service vessel model. Additionally, information from Kaiser *et al.*, (2014) can be used to compare helicopter to service vessel service and construction markets.

**References:**

- Dismukes, D.E. 2010. *Fact book: Offshore oil and gas industry support sectors*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-042. 138 pp.
- Eastern Research Group, Inc. 2011. *Analysis of the oil services contract industry in the Gulf of Mexico region*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico Region, New Orleans, LA. OCS Study BOEMRE 2011-001.
- Helicopter Safety Advisory Conference. 2014. Helicopter Safety Advisory Conference (HSAC) Gulf of Mexico Offshore Helicopter and Safety Review. April 19, 2014. <http://www.hsac.org/portals/45/HSAC%202014%20Report.pdf> (accessed September 10, 2015).
- Kaiser, M., S. Narra, and A.G. Pulsipher. 2014. *Modeling the offshore logistical network in the Gulf of Mexico*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. DRAFT OCS Study.

**Revised Date:** March 24, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** Characterization of Receiving Waters in the Gulf of Mexico

**BOEM Information Need(s) to be Addressed:** Ocean discharge of produced water is regulated under general National Pollutant Discharge Elimination System (NPDES) permits issued by EPA Regions 4 and 6, and allow well treatment fluids, completion fluids, and workover fluids to be commingled and discharged with produced water, resulting in considerable variability of the waste stream chemistry. The NPDES permits require limited sampling and analysis of produced water prior to discharge, and a mixing zone allows modeling of contaminant concentrations at a compliance radius of 100 m. The NPDES permit is presumed to meet requirements of the Clean Water Act (CWA), 40 CFR 125.121, to prevent “unreasonable degradation of the marine environment,” as defined at 40 CFR 125.122. Therefore, these discharges are considered to pose “negligible” impact to receiving waters with respect to NEPA. Since the NPDES permits rely on modeling, this study will inform NEPA by characterizing actual levels of produced water contaminants in receiving waters outside the 100 m NPDES compliance radius to demonstrate if the intent of the CWA is being achieved. Depending on actual conditions revealed by the study, the impact category for these discharges may need to be changed in NEPA from “negligible” to “minor” or “moderate.”

**Approx. Cost:** (in thousands) \$300

**Period of Performance:** FY 2017–2018

### **Description:**

**Background:** Contaminants in produced water may include elevated total dissolved solids concentrations, organic compounds associated with hydrocarbons in the formation, inorganic metals and naturally-occurring radioactive material (NORM) that may leach from some formations, and contaminants in well treatment fluids, completion fluids, and workover fluids that are commingled in produced water prior to discharge (Argonne National Laboratory *et al.*, 2015). Laboratory analyses currently required by the NPDES permits include oil and grease (once per month), and acute toxicity (once per year after four consecutive calendar quarters). The analytical results are self-reported by operators to the EPA Integrated Compliance Information System (ICIS) database.

This study has been designed to bypass the theoretical provisions of the NPDES permit, and evaluate with empirical data if produced water discharges achieve the intent of the CWA; specifically, whether levels of contaminants present in receiving waters are consistent with definitions at 40 CFR 125.122.

## Objectives:

- To determine concentrations in receiving waters of dissolved contaminants known to be present in produced water.
- To evaluate if empirical data are consistent with the NPDES permit process.
- To determine if contaminants detected in receiving waters are adequately characterized by sampling for NPDES permit.

Methods: Table 7 in Argonne National Laboratory *et al.*, (2005) includes produced water discharge volume estimates for 50 platforms that were sampled as part of the study. BOEM will select three facilities from Table 7 based on discharge volume to be evaluated in this study.

Develop sampling and analysis plan for receiving waters, to horizontally and vertically delineate dissolved contaminants known to be present in produced water (including but not limited to VOCs, SVOCs, priority pollutant metals, cyanide, and radionuclides <sup>226</sup>Ra and <sup>228</sup>Ra, pH, and TDS). Up to 50 water samples are budgeted for analysis of these parameters, including background samples. Sample locations will be based on current direction at time of sampling (from [www.ndbc.noaa.gov](http://www.ndbc.noaa.gov)), water depth and outfall locations/depths.

It is anticipated that unannounced BSEE platform inspections will be performed contemporaneously with water sampling to obtain the produced water discharge flow rate.

Perform evaluation if the produced water discharges are consistent with definitions at 40 CFR 125.122.

Prepare summary report, including analytical results in summary form with detection levels where analytes are not detected, maps and tables depicting sample locations (with GPS coordinates), contaminant isopleth maps for priority pollutants, and results of evaluation regarding consistency with definitions at 40 CFR 125.122.

## **References:**

Argonne National Laboratory, J.A. Veil, T.A. Kimmeol, and A.C. Rechner, 2005.  
*Characteristics of Produced Water Discharged to the Gulf of Mexico Hypoxic Zone*. Prepared for the U.S. Department of Energy, National Energy Technology Laboratory, 69 pp. Available at:  
[http://www.perf.org/images/Archive\\_Hypoxic\\_Report.pdf](http://www.perf.org/images/Archive_Hypoxic_Report.pdf).

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico, Western Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Baseline Monitoring of Avian and Bat Activity and Offshore Platform Interactions

**BOEM Information Need(s) to be Addressed:** Information regarding offshore avian activity is needed to provide a better understanding of possible interactions between birds and offshore structures associated with oil and gas activity. Impacts to birds that cause injury or mortality should be avoided, minimized, or mitigated per the Migratory Bird Treaty Act and Executive Order 13186 and in accordance with the NEPA process.

**Approx. Cost:** (in thousands) \$650

**Period of Performance:** FY 2017–2020

### **Description:**

**Background:** Millions of birds migrate each year with many crossing the GOM to reach their destination. In the 1990s, MMS supported a study that reported birds that were visually detected from certain oil/gas platforms and included the timing and any interactions with the associated structures. This report provided information that was not well understood; avian interactions with offshore structures and trans-gulf activity should be studied further. By replicating the previous study and including modern technology such as avian acoustic detectors, a baseline of avian activity in the offshore environment will be better documented. Bat activity will be similarly documented.

**Objectives:** This study will address avian species composition, abundance, and trans-Gulf migration phenology and any interactions with offshore structures from the location of the surveys. Bats will also be investigated.

**Methods:** Avian species composition and migration phenology will be analyzed. Russell's (2005) study will be replicated using autonomously recording technologies, such as acoustic detectors (*e.g.*, ATOM) and X-band radar to obtain additional information that may be missed during visual and auditory observations. New technology is available in the form of Acoustic and Thermographic Offshore Monitoring System (ATOM). It is capable of detecting bird flight calls and visual detection of incoming birds (approaching a platform). It can also detect bats. It is fairly large because it uses solar panels for power, but could potentially use electrical power available at offshore facilities. Also potentially useful technology, because it can detect nocturnal circulation, is X-band radar which is fairly compact (*e.g.*, it has been used by police in radar guns). Flying bats at night could create uncertainty of documenting nocturnal circulation in birds. Next-Generation Radar (NEXRAD or Nexrad), which is a network of 158 high-resolution Doppler weather radars operated by the National Weather Service, will be used to determine large movements of birds during migration season. Environmental data, including weather and oceanographic parameters, will also be collected to supplement the analyses. There could be maintenance on the equipment

that the industry would not be able to provide. Thus, a trained biological technician would perform the needed equipment maintenance and could also provide validation of autonomous measurements while at the facility by providing visual observations during their visit.

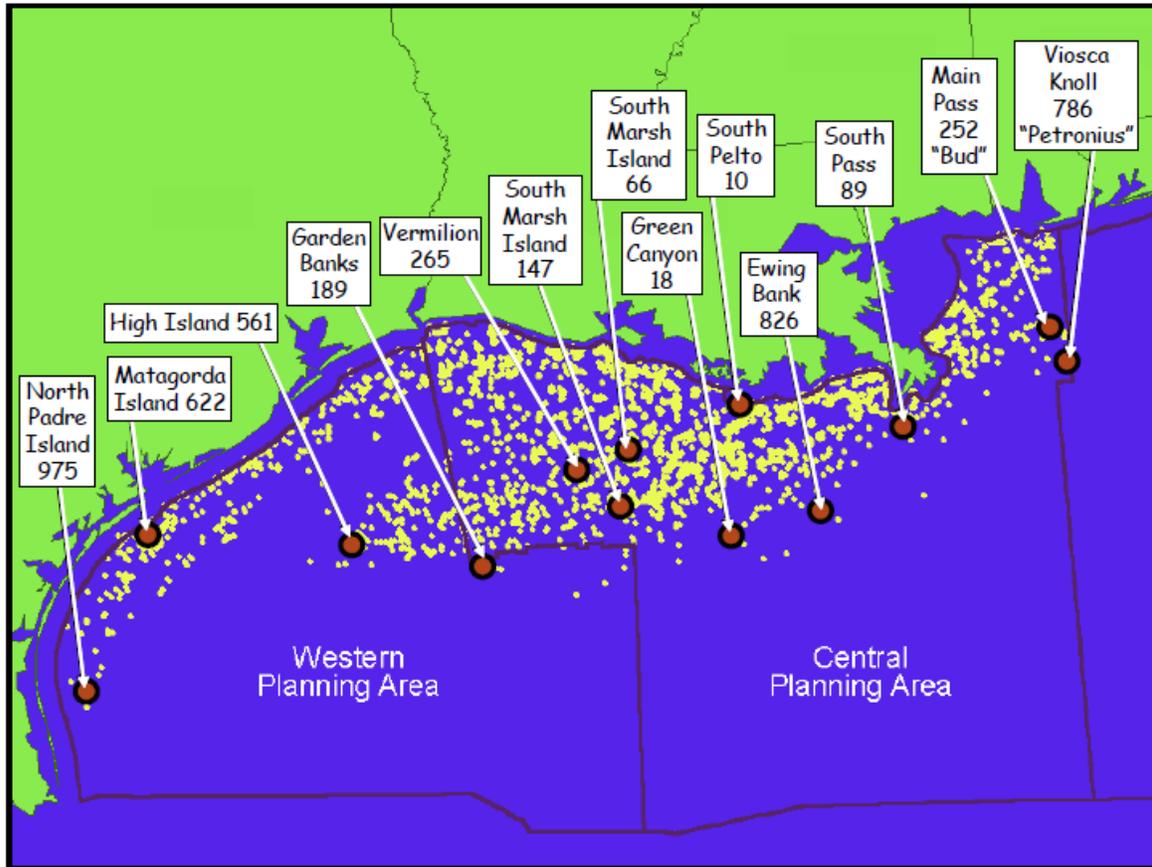


Figure 1: Map of locations of platforms used during offshore bird surveys in Russell *et al.*, 2005 (MMS 2005-009) and platforms in the northern GOM from the 2005 report.

### References:

Russell, R.W. 2005. *Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report*. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

**Revised Date:** February 9, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** OCS-Related Coastal Infrastructure Fact Book Update

**BOEM Information Need(s) to be Addressed:** BOEM requires updated OCS-related infrastructure information to support scenario development for environmental impact assessments required by the NEPA and conducted for GOMR lease sales. This information will inform BOEM decision-makers in their oversight and management of OCS resources as mandated by the Outer Continental Shelf Lands Act. The oil and gas industry utilizes many different types of onshore infrastructure from platform fabrication and pipe coating to waste disposal and product transportation. A clear understanding of these infrastructure types, their characteristics, utilization trends, and future outlook are critical for developing scenario projections that inform BOEM's environmental impact analyses across all resources.

**Approx. Cost:** (in thousands) \$230

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** BOEM funded three previous fact book efforts that have proved extremely useful and instructive, covering a broad range of critical infrastructure information with specific GIS data. The first fact book established the basic framework describing the characteristics, applicable regulations and industry trends and outlook for: platform fabrication yards; port facilities; shipyards/shipbuilding; support and transport facilities; waste management facilities; pipelines; pipecoating; gas processing and storage; refineries and petrochemical plants (The Louis Berger Group, 2004). The second fact book addressed the numerous support sectors that service OCS activities such as: drilling contractors; diving; ROVs; muds, drilling fluids and lubricant providers; air and water transportation; geophysical services; dredging; catering; workover services; and environmental consultation and mitigation services (Dismukes, 2010). After the devastating 2005 hurricane season, the next fact book was initiated to include updated facility information, a post-hurricane impact assessment, an additional chapter on power generation to address renewable energy, and a second volume to address issues of the surrounding communities (Dismukes, 2011; Kaplan *et al.*, 2011). Since the last fact book effort, several significant changes have occurred that necessitate an update:

- Removal of the Oil Export Ban by the U.S. Congress in December 2015;
- Development of several new crude oil storage facilities and export terminals in response to substantial increases in U.S. crude oil production;
- Considerable changes in energy markets related to the sustained crash in world energy prices and the expansion of onshore unconventional oil and gas markets;
- Major restructuring and reconfiguration of existing and planned U.S. pipelines;

- Conversion and development of new greenfield liquefied natural gas (LNG) export facilities along the GOM;
- A recent boom in new petrochemical manufacturing facilities along the GOM given low prices and abundant feedstock supplies (natural gas and crude oil); and
- Extensive, ongoing industry re-configurations through mergers and acquisitions, along with ownership shifts, which makes our current GIS data on facilities significantly out of date.

The updated fact book will include information about these new facilities, inter-modal transportation, and a database covering all OCS-related coastal infrastructure facilities with a GIS component including the requisite metadata for accurate mapping purposes.

**Objectives:** The objective of this study is to improve and expand upon the very successful fact book approach to understanding OCS-related onshore infrastructure and to inform the ongoing pervasive analytical task of developing forecasts scenarios for resources analyses included in BOEM environmental impact statements and assessments.

**Methods:** Primary and secondary information will be collected from a wide range of sources including: federal and state government databases, media and trade press publications, commercial sources, and other industry-related information such as trade association-specific publications and press announcements. GIS metadata will be compiled with a focus on quality assurance/quality control.

### **References:**

- Dismukes, D.E. 2010. *Fact book: Offshore oil and gas industry support sectors*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-042. 138 pp.
- Dismukes, D.E. 2011. *OCS-related infrastructure fact book. Volume I: Post-hurricane impact assessment*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2011-043 and 2011-044. 372 pp. and 163 pp., respectively.
- Kaplan, M.F., A. Laughland, and J. Mott. 2011. *OCS-related infrastructure fact book. Volume II: Communities in the Gulf of Mexico*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2011-043 and 2011-44. 372 pp. and 163 pp., respectively.
- The Louis Berger Group, Inc. 2004. *OCS-related infrastructure in the Gulf of Mexico fact book*. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2004-027. 234 pp.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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: Sociocultural Monitoring

**BOEM Information Need(s) to be Addressed:** One of the top priorities for BOEM is to strengthen its monitoring of the OCS program under NEPA. This study will update the BOEM study *Social and Economic Impacts of Outer Continental Shelf Activity on Individuals and Families* (Austin *et al.*, 2002) and develop it into the basis for a socioeconomic monitoring system. The original Austin *et al.*, 2002 study has served as the primary source for BOEM analyses of local-level socioeconomic conditions and effects for the last 14 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 this urgent need to establish a methodology and system for continued monitoring. Because this monitoring system will consist of provide rich, systematic and comparable information overtime through repeated studies it will, like the original Austin *et al.*, 2002 continue to provide significant support for social and economic impact analyses in all NEPA-related documents.

**Approx. Cost:** (in thousands) \$675

**Period of Performance:** FY 2017–2020

### **Description:**

**Background:** The coastal Gulf, its communities, and the OCS industry have gone through many changes and witnessed great shocks during the last several years and as a result, Austin *et al.*, (2002), the basic source for community-level socioeconomic baseline and analysis, needs to be updated. As an extension of the original BOEM study, this effort represents an important first step toward establishing a strong socioeconomic monitoring system in the GOMR. This study will establish the methodology for sociocultural monitoring and will 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 that will be driving Gulf oil or shaping Gulf families 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 *et al.*, (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. These materials would provide BOEM with the basic blueprint for follow up monitoring studies that will be repeated approximately once a decade.

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 such as literature review, field-based ethnography and community partnering (*e.g.*, crowd sourcing). The study will include the 2 original and 1 additional study communities. 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.

### **References:**

Austin, D., K. Coelho, A. Gardner, R. Higgins, and T. McGuire. 2002. *Social and Economic Impacts of Outer Continental Shelf Activities on Individuals and Families. Volume I: Final Report*. Prepared by the University of Arizona, Bureau of Applied Research in Anthropology, Tucson. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. OCS Study MMS 2002-022. 298 pp.

**Revised Date:** March 24, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Mapping the Late-Pleistocene Landscapes of the Gulf of Mexico through 3-D Seismic Analysis

**BOEM Information Need(s) to be Addressed:** BOEM is tasked, under Section 110 of the NHPA and Section 101(b)4 of the 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, BOEM-funded 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 with current line spacing requirements. 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 Eastern and Atlantic Planning Areas.

**Approx. Cost:** (in thousands) \$400

**Period of Performance:** FY 2017–2019

### **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 to meet BOEM's obligation under NHPA Section 110; therefore, BOEM prefers to avoid and protect any buried paleolandform (interpreted from sonar sub-bottom profiler data) that potentially dates to the Late-Pleistocene/Early Holocene. To date, no buried prehistoric sites have been confirmed on the OCS in the Western and Central GOM. In 2005, geologists and geophysicists at the University of Birmingham, United Kingdom developed a methodology to investigate sub-seafloor stratigraphy representing paleolandscapes exposed during the Late Pleistocene/Early Holocene and created a regional paleolandscape model by employing preexisting 3-D seismic survey data collected by the oil and gas industry (Gaffney *et al.*, 2007). 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 3-D seismic data are available for the Western and Central GOM, but geomorphic response to sea level rise in the northern GOM was quite different than the southern North Sea because of open shelf versus confined fluvial valley settings, respectively. However, select areas of

the northern GOM where major stream systems (*e.g.*, the Mississippi) cut large valleys on the exposed shelf during the Last Glacial Maximum would be candidates for similar modes of paleolandscape preservation as those observed in the southern North Sea.

**Objectives:** The primary objective of this study is to replicate the Doggerland 3-D seismic analysis project on the GOM shelf within the Late Quaternary Mississippi River incised valley using existing industry-produced 3-D seismic datasets coupled with higher resolution geophysical data and geologic data to create a regional paleolandscape model. Project goals include:

- To employ 3-D seismic data and other available resources to interpret Late Wisconsinan to recent incised valley fill character and the erosional/depositional response to sea level rise (sequence stratigraphy) within the Mississippi River incised valley on the GOM shelf;
- To ground-truth and verify Late Pleistocene/Early Holocene stratigraphic interpretations with available subsurface geologic (core) data;
- To create a process-response model that predicts preservation potential for subaerially exposed landforms and prehistoric archaeological sites within the incised valley;
- To provide paleocoastline data which may be used to develop and calibrate sea level and paleolandscape models.
- Based on conceptual model above, develop a tool that can inform BOEM decisions on how to better identify and avoid potential prehistoric cultural resources on the shelf.

**Methods:** BOEM is provided processed 3-D 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 3-D 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), post-processing to better resolve the shallow sections of interest, analysis, and modeling. The third year of the study, 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. Identify a 3-D seismic data set with which the area of interest may be resolved;
2. Map regionally significant reflectors using the regional 3-D seismic dataset;
3. Interpret these surfaces using artificial illumination and horizon attributes such as amplitude and dip to identify morphological features and developmental chronology;

4. Generate seismic attributes for the regional 3-D seismic dataset;
5. Sequentially time-slice these attribute volumes (*e.g.*, amplitude, coherence, RMS amplitude) and to employ opacity rendering techniques to identify morphological features and the developmental chronology;
6. Integrate the above to interpret stratigraphic architecture and develop a sequence stratigraphic model from that will ultimately be employed to produce a process-response conceptual geomorphic model to predict paleolandscape preservation potential within the valley;
7. Use existing high-resolution 2-D seismic data and borehole data to refine the stratigraphic model, provide material suitable for age-dating, resolve interpretational and chronological ambiguities, and to provide paleoenvironmental data;
8. Generate digital spatial models that can be imported into a GIS for map production and spatial analysis; and
9. Develop data type, collection, and analysis recommendations for the improvement, enhancement, and expansion of this research.

**References:**

Gaffney, Vincent, Kenneth Thomson, and Simon Fitch (Eds.). 2007. *Mapping Doggerland: The Mesolithic Landscapes of the Southern North Sea*. Archaeopress, Oxford, England.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Archaeology and Coast in Crisis: Traditional Cultural Properties At Risk

**BOEM Information Need(s) to be Addressed:** Under the OCS Lands Act, BOEM has a responsibility to address the needs expressed by States that may be affected by BOEM's OCS programs. The State of Louisiana has expressed concerns about the loss of coastal archaeological sites due to erosion, subsidence, and sea-level rise, and the effects of their loss from the Native American perspective. The State has repeatedly expressed the critical need to document archaeological sites threatened by sea-level rise and coastal erosion as well as document how Louisiana's communities (modern, descendant, and Tribal) are affected by the loss of archaeological sites and traditional cultural properties (TCPs). These concerns were also voiced by the Choctaw Nation of Oklahoma during recent BOEM consultations under Section 106 of the NHPA, Executive Order (E.O.) 13175, and Secretarial Order 3317. State concerns included offshore oil and gas-related infrastructure (*e.g.*, pipelines) and activities such as increased vessel traffic that passes through state lands and may affect submerged archaeological sites, some of which are known to contain human remains. The proposed study will provide important information to the State of Louisiana for cultural resource management purposes as well as inform BOEM's NEPA analyses related to the effects of OCS oil and gas-related activities on coastal archaeological sites. This study proposes to develop strategies for managing at-risk archaeological sites along Louisiana's coast, incorporate Tribal community involvement, and recommend how BOEM should incorporate these considerations in its consultations and NEPA analyses. The National Parks Service started similar land-loss planning within their Parks. BOEM will need to address land-loss within states affected by BOEM's OCS-related activities (Rockman 2015).

**Approx. Cost:** (in thousands) \$975

**Period of Performance:** FY 2017–2024

### **Description:**

**Background:** The State of Louisiana contains 40% of the nation's wetlands and experiences 90% of the land loss in the lower 48 states, equivalent to approximately 25 to 35 square miles per year (LA DNR 2015). The rapid loss of Louisiana's coastline is not only an environmental crisis, but a resource management crisis as well. The loss of critical archaeological information will hamper the State's efforts to document, manage, and protect its non-renewable cultural resources. According to Louisiana's Office of Cultural Development Historic Preservation Plan, "One of the greatest challenges...is the task of simply identifying significant historic properties before they are altered or destroyed. This is particularly true for the less tangible properties such as cultural landscapes or traditional cultural properties..." (LA OCD 2011). This study will support BOEM's assessments and consultations by identifying the effects of coastal erosion and archaeological site loss on local communities, descendant communities, and Tribal

groups, so that BOEM will have the requisite data to make informed decisions about its future programmatic activities. The study will provide baseline information on identified groups and insights into how specific groups have been affected by archaeological site loss in the past and how they may be affected by ongoing coastal erosion and site loss. As erosion progresses, new and future OCS-related infrastructure could pass through undetected, submerged archaeological sites, causing irreparable damage and loss of information. Under E.O. 13175, federal agencies are required to consult with affected Tribes on actions that have Tribal implications. This study will provide an opportunity to identify affected Tribes and begin a dialogue to determine actions that require consultation. The information and analyses will be incorporated into Tribal consultations, consultations with affected Gulf States, NEPA documents, Environmental Justice analyses, and OCS-related programmatic reviews. Ethnographic research and partnerships with descendant communities and Tribes can provide critical information on the history and cultural significance of sites that are now threatened by erosion and land-loss. By taking a combined archaeological data-recovery and anthropological approach to understanding the importance of these sites, BOEM is assisting the State of Louisiana and Tribal communities with obtaining the information needed for their respective purposes (Sorset 2013).

#### Objectives:

- Document perspectives of descendant communities and Tribal groups on investigations of archaeological sites and TCPs endangered by coastal erosion, subsidence, and sea-level rise.
- Conduct archaeological investigations of a select number of sites identified by the State of Louisiana, descendant communities, and Tribal groups as critical. This selection process will offer multiple and diverse perspectives to inform BOEM on how archaeological sites potentially affected by BOEM's permitted actions should be managed.

Methods: Ethnographers and/or anthropologists will collect information from modern communities, descendant communities, and Tribal groups pertaining to their perspectives on the loss of archaeological sites and TCPs due to sea-level rise, erosion, and subsidence. Second, they will seek input into how submerged sites should be managed, documented, and/or mitigated by State or Federal agencies. Third, they will request information pertaining to the effects of subsidence and erosion on the spiritual significance of TCPs. Archaeologists will conduct data recovery excavations at five to ten threatened sites (depending on level of intensity) identified as likely to yield important information for the State of Louisiana, descendant communities, and Tribal groups. They will use established archaeological methodologies, and may require the use of alternative sources of transportation such as watercraft to access the selected sites. The study will result in both a Final Report and a Submerged Sites Management Plan. Based on the availability of funds, a version of this study with a reduced level of effort could be conducted for approximately \$650,000 with an option for later expansion of scope. This study is recommended for funding through a cooperative agreement and the Gulf Coast Cooperative Ecosystems Studies Unit.

**References:**

Louisiana Department of National Resources (LA DNR). 2015. Coastal Erosion: Facts and Figures. Restore or Retreat Program. Internet Resource; Accessed December 2015: [http://www.restoreorretreat.org/la\\_erosion\\_facts.php](http://www.restoreorretreat.org/la_erosion_facts.php).

Louisiana Office of Cultural Development (LA OCD). 2011. Our Places, Our Heritage: A Plan for Historic Preservation and Archaeological Conservation in Louisiana, 2011-2015. Internet Resource; Accessed December 2015: [http://www.crt.state.la.us/Assets/OCD/hp/SHPO/SHPO\\_Jan\\_2011.pdf](http://www.crt.state.la.us/Assets/OCD/hp/SHPO/SHPO_Jan_2011.pdf).

Rockman, Marcy. 2015. An NPS Framework for Addressing Climate Change with Cultural Resources. *The George Wright Forum* Volume 32(1); 2015. <http://www.georgewright.org/321rockman.pdf>.

Sorset, Irina Tidmarsh. 2013. Maritime Heritage Trails as Public Outreach Tools: An Ethnographic Model for the Apalachicola River, Florida. University of West Florida Master's Thesis Published 2013. Accessed December 2015: [http://etd.fcla.edu/WF/WFE0000390/Sorset\\_Irina\\_Tidmarsh\\_201306\\_MA.pdf](http://etd.fcla.edu/WF/WFE0000390/Sorset_Irina_Tidmarsh_201306_MA.pdf).

**Revised Date:** January 12, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western Gulf of Mexico, 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, socioeconomic changes, and regulatory changes have likely changed patterns of recreational behavior. This study would obtain information regarding 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 inform decisions regarding which structures should be maintained through Rigs-to-Reefs programs.

**Approx. Cost:** (in thousands) \$300

**Period of Performance:** FY 2017–2019

### **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. Hiatt 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. Hiatt and Milon (2002) also did not examine site-specific determinants of recreational uses of OCS infrastructure.

Since the Hiatt and Milon (2002) study, there have been various changes and events that could have altered recreational behavior along the Gulf Coast. For example, improved offshore communications, better safety technologies, and simplified navigational aids (*e.g.*, GPS) have allowed the OCS to become increasingly accessible to recreators. Public awareness of the oceans, environmental impacts, and climate change has resulted in increased ecotourism and other low-impact recreational activities.

Furthermore, the structure of the U.S. economy has evolved in various ways in recent years. How these factors have acted individually or in combination to impact recreational activity in the GOM is not known.

Recreational activities have been associated with nearshore infrastructure for decades. However, as more 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, 2016). 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. 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.

#### Objectives:

- Assess recreational demand for OCS infrastructure
- Assess recreational demand for Rigs-to-Reefs associated artificial reef sites
- Identify key factors for structures particularly suitable for recreational activities
- Identify and evaluate behavioral shifts (and anticipated shifts) resulting from removal of obsolete OCS infrastructure.

Methods: A methodology that entails conducting interviews with industry participants will be developed to address the objectives of this project. This methodology will obtain information from recreators and firms that provide recreational services; BSEE will also be involved to the extent regulatory issues that require coordination arise. The interview methodology will be flexible enough to adapt to information received from initial interview participants. This could be accomplished through staged interviews or snowball sampling 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. This methodology will also obtain information on site-specific determinants of recreational use, as well as information on the substitutability of recreational sites. The interviews will focus on current and potential future recreational usage of platforms; although information regarding historical usage patterns will be gathered to the extent interviewees are able to provide such information. The information obtained through these interviews will be synthesized with background information, statistical analysis, and mapping tools.

**References:**

Bureau of Safety and Environmental Enforcement (BSEE). 2016. Installations and removals—offshore production facilities in federal waters. Available at: <http://www.bsee.gov/BSEE-Newsroom/Offshore-Stats-and-Facts/Offshore-Stats-and-Facts/>.

Hiatt, R.L. and J.W. Milon. 2002. *Economic impact of recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico: Final report*. OCS Study MMS 2002-010. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. 98 pp.

U.S. Dept. of Commerce (USDOC) National Marine Fisheries Service (NMFS). 2012. Fisheries Economics of the United States, 2011. NOAA Tech. Memo. NMFS-F/SPO-128, 175p. Available at: <https://www.st.nmfs.noaa.gov/st5/publication/index.html/>. Accessed July 26, 2013.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Effect of Oil Contamination on Wetland Loss

**BOEM Information Need(s) to be Addressed:** BOEM scientists seek to understand how wetlands are impacted by oil spills in order to assess the cumulative impacts of OCS activity on coastal wetlands. BOEM will use the information to support the OCSLA and NEPA process when preparing Environmental Impact Statements. The proposed study would increase the understanding of oil spill environmental impacts, and could potentially be useful in development of clean-up strategies.

**Approx. Cost:** (in thousands) \$319

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** Coastal habitats, including wetlands, are important resources in the Gulf of Mexico region, providing habitat to an immense number of species of plants and animals. A USGS-NASA study applied polarimetric SAR (polSAR) images collected in 2009 (pre-oil spill), 2010 (*DWH* oil spill and clean-up), 2011 (oil spill clean-up), and 2012 (Hurricane Isaac) covering the heavy oil impact in Barataria Bay. That application documented for the first time that shoreline erosion dramatically increased during the clean-up period and that the intense shoreline recession caused by Hurricane Isaac distinctly differed in pattern from recession associated with the clean-up (Ragoonwala *et al.*, submitted RSE). That incisive study used limited photography for validation and covered only one of the severely oiled coasts. A complement study is needed now that extends the PolSAR mapping spatially to more of the Delta and to the present in conjunction with photographic shoreline mapping.

This study and the results are the first to map the actual physical response of the marsh and marsh shoreline to exposure to oil from an oil spill. This approach allows for direct mapping of oil in the marsh. While others have recently documented methods to detect high concentrations of oil, and some studies have documented what they believe to be excessive shoreline loss, these studies were spatially and temporally limited (McClenachan, *et al.*, 2013). The proposed study would provide direct mapping of excessive shoreline loss attributable to oil impact and the response to mitigate possible damage of the oil spill across a large area, encompassing much of the most heavily impacted shorelines. It will also directly document and locate different patterns of shoreline erosion associated with oiling (and possibly cleanup) and severe storms, apparently for the first time. The proposed study would also document changes in marsh structure that appear to be related to the oiling.

The ability to uncover these relationships and define magnitudes and trajectories over a four year period that brackets the pre to post oil spill and severe storm impacts relies on development of remote sensing and processing techniques and importantly the instrument, polarimetric SAR (or radar here for short). polSAR provides that capability

to directly track (1) oil (if the oil concentration effect produces enough change in the polSAR image), (2) marsh structure (a new development as well, both the density as well as the orientation), (3) temporal change at high spatial resolutions (2 m), (4) day and night and during almost all weather conditions, and (5) on demand.

Now that data from the Shoreline Cleanup Assessment Technique Program has documented the extent of the oiling of gulf shorelines from the *DWH* spill, and numerous studies have provided information on the impacts of oil contamination to shorelines, including plant mortality and recovery, one important aspect of the overall impact remains unknown: How are land loss rates affected by the oil spill impacts? This information is important in understanding the long-term effects of the spill, which is critical in our NEPA documents.

**Objective:** This study will extend the successful polSAR shoreline mapping spatially and temporally along with photographic shoreline mapping. The extension will give a deltaic view of the localized mapping results and their interpretations (*e.g.*, oiling, clean-up, storm). That holistic assessment will further establish the localized results and interpretations, quantify limitations and accuracies, and determine if and where adaptations of the methods are needed.

- The combined polSAR and photographic shoreline mapping will allow cross-validation of results and further substantiate a new mapping technology while providing photographic-based maps conforming to historic mapping.
- Extend the shoreline mapping from 2009 to 2015 (data now available) to selected deltaic coasts with known oiling and non-observed oiling. Those maps would increase the holistic assessment of the oil spill impacts and their long-term consequences to coastal wetland resilience.

**Methods:** polSAR mapping is based on a calibrated and georeferenced 2-m NASA-UAVSAR data product, web available image processing, and the USGS Digital Shoreline Analysis System based on common GIS procedures (Ragoonwala *et al.*, submitted RSE). Photographic collections in 2008, 2010, and 2011 to 2015 of the Delta are available. Those photographic sets will be interpreted to provide shoreline positions and combined with polSAR-based shorelines to calculate shoreline change.

### **References:**

McClenachan, Giovanna, R. Eugene Turner, and Andrew W. Tweel. 2013. Effects of oil on the rate and trajectory of Louisiana marsh shoreline erosion. *Environmental Research Letters* 8.4:044030.

Ragoonwala, A., Jones, C.E., Chi Z. and Ramsey III, E. In Review. Tracking Shoreline Change with High Spatial Resolution Synthetic Aperture Radar: Highlighting the Macondo-252 Oil Spill and Hurricane Isaac Impacts. Submitted to the *Remote Sensing of Environment* journal.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western Gulf of Mexico, Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Tracer Experiments for Atmospheric Dispersion Modeling

**BOEM Information Need(s) to be Addressed:** The assessment of the impact of air emissions, particulates, and toxic chemicals released from the OCS source on the onshore air quality is needed in the Sections of Air Quality and Impacts of Accidental Events in NEPA documents and BOEM's standard air quality review for oil and gas industries, which are required in the Clean Air Act and NAAQS. BOEM needs to collect tracer and meteorological data to evaluate the applicability of the existing air dispersion models (AERMOD and CALPUFF) for offshore applications. Recently, the EPA has set more stringent air quality regulations and also considers replacing the EPA older air quality model with the AERMOD dispersion model for short-range applications. The CALPUFF model is used for long-range applications. Originally, the AERMOD model was considered to replace the BOEM's OCD air quality model. However, the AERMOD and CALPUFF models (EPA) were developed for overland applications. As such the applicability of these models to the offshore and coastal areas is not justifiable. Therefore, currently EPA does not recommend these models for offshore applications, since there are no credible offshore tracer and meteorological data to substantiate the AERMOD model as well as the CALPUFF model. Furthermore, for the GOM, 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 and verified in the marine and coastal environments. The proposed study is to meet the EPA requirements for air quality modeling.

**Approx. Cost:** (in thousands) \$1,900      **Period of Performance:** FY 2018–2019

### **Description:**

**Background:** BOEM has ongoing studies including *Air Quality Modeling in the Gulf of Mexico Region* (in a progress report by ENVIRON), which also recommended a tracer study program to investigate 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*. This meteorological model is a driver for the air quality model and to correct the deficiencies of the WRF meteorological model. The meteorological model will also be used for the real-time model simulations to aid and design the tracer experiments. A meteorological field program to collect the meteorological and wave data over the water has also been proposed in the past. The meteorological model is crucial in the success of the accurate prediction of air concentrations and thus for the air quality impact assessment. 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 the 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 and model validation.

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; and
- 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 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 releases will be conducted under various atmospheric conditions.

The tracer sampling equipment will be set up along the coastal shoreline. The measurements include the surface and upper air meteorological 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 MHz Radio Acoustic Sounding system for the measurements of the vertical profile of virtual temperature), ceilometer for mixing height measurements, microwave radiometer, Sonar, LiDAR, buoy, and radiosondes or meteorological tower.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** Environmental Studies Program: Support for the Synthesis of Gulf of Mexico Region Socioeconomic Research

**BOEM Information Need(s) to be Addressed:** The ESP has supported a large number of socioeconomic studies in the GOMR that addressed a wide spectrum of subjects concerning the OCS petroleum industry and its impacts. The number of study reports, their richness, and the fact they discuss multiple topics and the discussions change over time all conspire against the efficient incorporation of these materials into GOMR socioeconomic assessments. A synthesis is desirable. GOMR staff will begin developing one, an effort addressing two BOEM information needs: 1) The Bureau seeks to simplify EISs and, at the same time, strengthen socioeconomic analyses. The synthesis will produce reference documents that will support this new-style of EIS. It will also facilitate use of study materials by categorizing them; and 2) It will provide a “roadmap” of past research that will facilitate study planning and program review.

**Approx. Cost:** (in thousands) \$220

**Period of Performance:** FY 2018–2019

### **Description:**

**Background:** Since the ESP was organized under the Minerals Management Service (now BOEM), the Bureau has supported numerous socioeconomic studies in the GOMR that addressed a wide spectrum of subjects concerning; for example, the petroleum industry, its operations and evolution, the socioeconomic effects of its normal operations, the socioeconomic effects of its business cycles and of oil spills, issues of environmental justice, issues of the geographic distribution of socioeconomic effects, and related issues of economic and demographic modeling. Even by the year 2000, the Bureau’s Scientific Advisory Committee and others were arguing the need for a synthesis of the Gulf’s research. A haphazard review of Gulf social science (Murdock, Leistritz & Albrecht 2002) demonstrated the inability of outsiders to comprehend the vastness of the program even then, at least given the time available for reviews. That was early in the program, before its florescence.

While GOMR social and economic research has increased dramatically over the past several decades, many findings await assimilation into GOMR documents (or are not clearly referenced in them). A synthesis will support several agency goals. First and foremost, it will make newly minted information more accessible to analysts and decision makers in formats appropriate to their tasks. They will encourage GOMR-supported academic research on the Gulf Region and its petroleum industry. (As the synthesis progresses, these assemblages of large, coherent blocks of information could be made accessible to the interested public and facilitate agency interactions with States and other stakeholders.) The synthesis roadmap will support the evaluation and

monitoring of the BOEM ESP by helping to identify significant outstanding questions and data gaps, a key to effective planning, and by providing support to future outside reviews of the program. Developing this synthesis will be a multi-step undertaking. As noted already, while, in the past, the Bureau has relied on independent reviews to improve the program's design and operations, these reviews lacked a "roadmap" that would have helped them navigate through this extensive, complex program.

The first step in this undertaking is an effort that combines the in-house knowledge of the program with expert and technical support to develop the "roadmap" for the synthesis—the outlines, concepts, issue papers, reviews, assessments, summaries, and other documents that will guide the production of the later synthesis effort.

The second step will be developing a contract to complete the synthesis design. While the analytic categories/topics await definition, the synthesis will address such concerns as: economic/demographic modeling; oil spills; the complex and geographically varied composition of the industry and the differences among its constituent parts in organization, labor needs, and resource requirements; temporal and spatial variability in the socioeconomic effects within the region; environmental justice; fisheries, tourism, and relations between them and the oil industry; and, effects to families, among others encountered in these reports. The intent is to establish a synthesis that will be regularly updated.

Objectives: This study will provide expert and technical support to an in-house effort by BOEM socioeconomic staff to establish the "roadmap" for a synthesis of GOMR socioeconomic research. Types of support functions are described in "Methods." The objective of the in-house synthesis is not completeness, but rather to establish a roadmap for one that will, at minimum, include:

- A list of studies including descriptions of methods and findings;
- A history of GOMR socioeconomic research;
- Key analytic categories/topics keyed to socioeconomic assessment; and
- Study materials and papers associated with these categories/topics.

Methods: An Indefinite Delivery, Indefinite Quantity Contract will provide support over a three-year period to the in-house effort to prepare a synthesis of GOMR socioeconomic research. Deliverables may be, but will not be limited to, written expert advice from expert individuals or panels, written reviews, summaries, or assessments of one or several documents, and face-to-face discussions.

(Methods for in-house [major] portion of the synthesis effort will consist primarily of literature review, coding and discussions with experts. Literature will consist primarily of published and unpublished BOEM/MMS study materials but may include other works such as related journal articles. Effort will be determined by other Bureau work assignments.)

**References:**

Murdock, S.H., F.L. Leistritz and S. Albrecht. 2002. *An Examination of Selected Recent MMS Socioeconomic Studies and Assessments in the Gulf of Mexico*. U.S. Dept. of the Interior, Minerals Management Service, Environmental Studies Program, Herndon, VA. OCS Study MMS 2002-057. 62 pp.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 Sabine Pass Project

**BOEM Information Need(s) to be Addressed:** 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 operators to commission geophysical surveys and archaeological assessments. 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 that BOEM-permitted activities do not impact them. Though no submerged prehistoric sites have been unequivocally identified on the OCS in this region, evidence of a potential site was found near a *ca.* 8,000 year-old shell deposit in the Sabine Pass Area lease blocks during a 1986 MMS study (Pearson *et al.*, 1986). Geological and geophysical data acquired since the 1986 study, and results from a more recent BOEM study, have yielded additional information about the potential for preserved paleolandscapes in the Sabine Pass Area. Further investigation of the potential site in the Sabine Pass Area may yield important information, not only about prehistoric sites within the now-submerged OCS but also fluvial and coastal geomorphologic response to sea-level changes in this region over time. This study will expand upon results of a 1986 MMS study and ground-truth with geologic data the geospatial compilation and analysis of geophysical data conducted as part of a recent BOEM study in the Western GOM OCS.

**Approx. Cost:** (in thousands) \$600

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** 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. Distinct depositional and erosional episodes in the northwestern GOM interpreted from stratigraphy can be linked to variable fluvial, estuarine, and coastal response to sea-level fluctuations and rates of change, and variations in continental sediment supply to the coast—processes and attendant landscape evolution responses that 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. BOEM previously funded studies to obtain a better understanding of the preservation potential for 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 incised 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; 2014). This study conducted close-interval seismic surveys, submerged paleolandform reconstructions, and limited vibracore testing. Vibracore analyses identified carbonized fish bone and other faunal remains as well as carbonized floral remains (*e.g.*, seeds, nuts) in two discrete areas in Sabine Pass Area Block 6: one found on a landform at the junction of two Sabine River paleodistributary channels; the other within a nearby shell deposit consisting exclusively of *Rangia cuneata* and exhibiting evidence of subaerial exposure during deposition (Pearson *et al.*, 1986:152). The high quantity of carbonized materials and their recovery from multiple strata within and below the transgressive zone strongly suggests the potential for preserved features, possibly associated with prehistoric human occupation prior to marine transgression. A recent BOEM 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), compiled and synthesized existing high-resolution seismic, sub-bottom profiler, and core data from various sources into a single GIS database for offshore Louisiana and Mississippi. This study has contributed new and promising information about paleolandform preservation potential in the Sabine Pass area.

#### Objectives:

- Test and determine the archaeological potential of two submerged paleolandform features in Sabine Pass Area Block 6;
- 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) and recommend any additional modifications or enhancements as appropriate;
- Develop seismic type facies based on information gained from geological and geophysical data that can be applied to identify similar paleolandforms on cultural resource surveys;
- Recommend best management practices for identifying and testing intact paleolandscape features on the Gulf of Mexico OCS to ensure that submerged prehistoric sites are not impacted by BOEM-permitted activities.

#### Methods:

- Analyze existing geophysical datasets and conduct additional geophysical surveys and systematic, high density coring operations within Sabine Pass Block 6 to determine the presence/absence of archaeological deposits and cultural materials and delineate their extent;
- Collect sediment, floral/faunal, and other relevant samples as necessary to inform paleoenvironmental reconstructions and age-dating.

**References:**

Pearson, Charles E., David B. Kelley, Richard A. Weinstein, and Sherwood M. Gagliano. 1986. *Archaeological Investigations on the Outer Continental Shelf: A Study Within the Sabine River Valley, Offshore Louisiana and Texas*. Coastal Environments, Inc. Baton Rouge, LA. U.S. Dept. of the Interior, Minerals Management Service, OCS Study MMS-86-0119.

Pearson, Charles E., Richard A. Weinstein, Sherwood M. Gagliano, and David B. Kelley. 2014. Prehistoric Site Discovery on the Outer Continental Shelf, Gulf of Mexico, United States of America. In Amanda M. Evans (ed.) *Prehistoric Archaeology on the Continental Shelf*. Springer, New York, NY.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** The Offshore Support Supply Vessel, Construction and Labor Market Industries in the Gulf of Mexico

**BOEM Information Need(s) to be Addressed:** BOEM documents onshore OCS-support industries as the “drivers” of socioeconomic consequences, focusing on questions of location, activities, and labor markets. Although BOEM has studied selected ports that host fabrication industries, no study has tied together the Gulf Coast offshore support vessel (OSV) construction and labor market industries with regional economies. This piece of the picture is critical: the Gulf Coast OSV industry is worth between \$1 and \$2 billion per year, three to four times the size of the U.S. drilling rig construction industry. The information is also important to BOEM goals of improving localized socioeconomic impact assessments since the OSV industry is geographic concentrated and this shifting industry requires documentation. Thus, this study will directly support for GOM EIS and EA socioeconomic analyses and MAGPLAN modeling.

**Approx. Cost:** (in thousands) \$325

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** Virtually all equipment, chemicals, fuel, food and materials used on the OCS is transported by OSVs. Over time, OSVs have evolved from vessels repurposed for use on the OCS to ones designed to perform specific functions such as platform supply vessels, crewboats, and anchor-handling vessels. The service market includes firms that own and operate vessels or that lease them to exploration and production companies. The construction and repair market supplies the service market with new vessels and performs maintenance and repairs. The labor market provides the crews to operate the vessels and the shipyard personnel to maintain, repair, and construct OSVs. The service and construction markets have different structures, different labor components, different regional distributions, and different economic and environmental impacts on local communities.

The Merchant Marine Act of 1920 (commonly called the Jones Act) requires that all vessels used in trade between two U.S. ports (including points on the OCS) be built in U.S. shipyards and crewed by U.S. citizens. As a result, while much of the U.S. commercial shipbuilding industry and almost all drilling rigs have been displaced by Asian competitors, OSVs are still built in U.S. yards that support local economies. OSV construction is heavily concentrated along the Gulf Coast of Louisiana and Alabama and the industry is economically and culturally important to that region.

OSV construction is much larger than rig construction in terms of employment and community impacts, and the disparity will grow as the U.S. rig construction market declines and service requirements in the deepwater GOM grow. OSV construction is

localized in a small number of rural communities including Bayou La Batre, Larose and Lockport, and likely represents a large proportion of total employment and economic activity in these communities. It is therefore important to understand how changes in this demand will impact such communities. New regional markets (e.g., Brazil, Mexico) may also have an impact on Gulf Coast construction activity which will need to be distinguished and separated from U.S. GOM activity. It is important that policy makers have quantitative data on the size, geographic distribution, economic and labor impacts of significant markets that relate to offshore development.

The OSV construction industry is a significant economic driver in the Gulf Coast region and little quantitative information is known about it. However, while many onshore consequences of OCS activities do not lend themselves to reliable quantification or are estimated with highly uncertain empirical models, the OSV construction industry promises to be an exception since it is directly subject to observation and classification. Since its operations also generate onshore consequences—employment, port activity, traffic, erosion, air quality, and others—its intensity and distribution are important to quantify for those impacts, but also as a roadmap for what is possible for other research and, more broadly, to assist in planning and regulatory activities.

**Objectives:** The research objective is to enhance and expand the understanding of the OSV OCS support sector, and to serve as source material for BOEM’s EISs, planning and regulatory requirements by addressing, for the past 15 years, questions of:

- Operations and organization
- Labor force and employment trends
- Market conditions and dynamics
- Geographic distribution

**Methods:** The study will describe the organization of the OSV service and construction industry and their markets by segment (e.g., crewboat, offshore supply vessel, anchor handling towing supply vessels) and their geographic distribution, including the major players, integration, trends, labor requirements, and market concentration. The study will estimate the size of the OSV service, construction and labor markets and compare them against the U.S. drilling rig service, construction and labor markets. The study will create a database of OSV orders, deliveries, and costs at U.S. shipyards from 2001 to 2016 and use these data to: a) describe the construction market size and its geographic distribution over time; b) estimate vessel costs by class; and c) estimate material usage and source in construction. The study will describe the factors influencing demand in the service and construction markets and the regulatory factors that influence construction demand, including policy responses to the *Deepwater Horizon* oil spill and BOEM leasing decisions. Source materials may include, among others, individual interviews, local and industry press reports, company annual reports and trade publications such as such as Marine Log and Workboat Magazine, RigLogix, and the Coast Guard PSIX database on vessel specifications. Where feasible, data should support quantitative regional economic impact estimates.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Preliminary Evaluation of the Mississippi Canyon Drum Disposal Site

**BOEM Information Need(s) to be Addressed:** As stated in Chapter 3.3.2. of the Gulf of Mexico Multisale Draft Environmental Impact Statement 2017–2022, BOEM identified documentation that describes ocean dumping in the Gulf of Mexico under permit provisions in Section 102 [33 U.S.C. 1412] of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA, also known as the “Ocean Dumping Act”). The National Academy of Sciences report, “Assessing Potential Ocean Pollutants” (NAS, 1975) documents the 1973 dumping of 208,000 waste barrels of industrial chemicals in Mississippi Canyon, located in the Central Planning Area of the OCS, of which approximately 55,000 barrels contained chlorinated hydrocarbons.

Based on information in the NAS report and the timeline, it is likely that the disposed chlorinated hydrocarbons are dioxin waste products from the manufacturing of Agent Orange. The drum disposal site can be seen on proprietary shallow hazard surveys in 59 lease blocks in Mississippi Canyon, as listed in Proposed Notice of Sale Package Central Gulf of Mexico Planning Area (CPA) Outer Continental Shelf (OCS) Oil and Gas Lease Sale 241 (BOEM, 2016b).

This proposed study will collect the first environmental data to evaluate if the Mississippi Canyon Drum Disposal Site has potentially released waste products that may be impacting water quality.

**Approx. Cost:** (in thousands) \$1,500      **Period of Performance:** FY 2017–2018

### **Description:**

**Background:** The drum disposal site is located near and around the Shell Mars Platform, and is in space-use conflict with oil and gas operations. One contractor is currently in discussions with BSEE regarding installing a new pipeline through the drum field. Such activities require BOEM analysis under the National Environmental Policy Act (NEPA), but currently the bureau does not have sufficient information with which to evaluate the potential environmental impacts of its permitted activities within the drum disposal site.

### **Objectives:**

- To establish an initial focused study area for current and future research, to test sampling methodologies and obtain baseline data for long-term monitoring, while limiting the extent of potential disturbance from evaluation.

- To evaluate the physical condition of the drums in the study area using a ROV to observe for evidence of drum damage and leakage.
- To characterize possible impacts to water quality.

**Methods:** Based on preliminary mapping of shallow hazard surveys performed by industry, a large number of drums are located in the northern portion of the drum disposal area and may be an accumulation from short-dumping (dumping prior to arriving at the permitted dumping area).

The study will commence by running high-resolution multibeam in survey mode through the area of suspected short-dumping. Based on these data, the location of the focused study area will be established over a 1-km by 1-km area where the highest density of drums is found. The study area will then be mapped for full-bottom coverage using multibeam and photomosaic or similar technologies. These data will be georeferenced for use in GIS applications.

Based on the study area mapping effort, several sites will be selected for close ROV inspection to image the drums and markings to identify the drum type and wall thickness specifications, and observe for potential damage or evidence of leakage.

Samples of benthic water column and sediment pore water will be collected in close proximity to the drums at several locations using a ROV with expendable sediment probes. Water sample analysis will include but not be limited to VOCs, SVOCs, PCBs, pesticides, herbicides, dioxins, furans, priority pollutant metals, cyanide, and radionuclides. Up to 50 water samples are budgeted for analysis of these parameters, including QA/QC and background samples. In addition, an onboard GC-MS will be used to perform real-time sample analyses to guide sampling efforts.

A summary report will be developed, including analytical results in summary form with detection levels where analytes are not detected, georeferenced multibeam and photomosaic imagery, maps, photographs and tables depicting sample locations, and contaminant isopleth maps for priority pollutants.

### **References:**

Bureau of Ocean Energy Management (BOEM). 2016. Proposed Notice of Sale Package Central Gulf of Mexico Planning Area (CPA) Outer Continental Shelf (OCS) Oil and Gas Lease Sale 241. Available at: <http://www.boem.gov/PNOS-241-Package/>.

**Revised Date:** February 22, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico, Western Gulf of Mexico

**Administered By:** Gulf of Mexico Region

**Title:** Houston and New Orleans: Urban Centers, Urbanization, and the Gulf of Mexico Petroleum Industry

**BOEM Information Need(s) to be Addressed:** This study addresses two informational needs, one stemming from NEPA guidance and socioeconomic assessment, the other from the Bureau’s economic modeling. First, this study advances the GOMR’s ongoing and challenging effort to strengthen local-level socioeconomic assessments. This study will provide local-level socioeconomic assessments for the two urban areas where the majority of past OCS effects have occurred and many future ones will occur. In doing so, this effort will also provide tools to support additional local-level assessments of GOM urban areas. Second, the GOM offshore petroleum industry has been undergoing continuous reorganization since the mid-1980s and one significant outcome has been the concentration of more industry in Texas, particularly in Houston, at the expense of New Orleans, a transformation encountered in MAGPLAN modeling as a “data problem.” This study will provide information on the changing Houston/New Orleans situation that should refine BOEM modeling and industry assessments.

**Approx. Cost:** (in thousands) \$375

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** Beginning with a 2005 planning conference, reviews by the National Research Council, the Gulf States, and other stakeholders all directed the GOMR to develop more local-level socioeconomic assessments (NRC, 1992; Luton and Cluck, 2004; McKay and Nides, 2005). The GOMR’s two-decades-long effort to do this has made great progress but has also faced great difficulties because of the magnitude, geographic reach, and variability of onshore OCS-related activities, because of the many types of oil-related activities and their 100-year-long integration into their social surroundings and because of the variety of surroundings found within the GOMR. The effort has been iterative, advances have been uneven and, on occasion, have led to changes in the way the GOMR approaches questions of local-level effects. This study is part of those occasions. The GOMR study effort is divisible into three basic thrusts: a focus on the baseline, on the various sectors of the OCS-related industry, and on types of social impacts. This study of Houston and New Orleans synthesizes these under the GOMR’s current understanding of baseline dynamics.

The GOMR has sponsored many baseline and community studies that subdivided the Gulf region and described one or many of its parts. *Benefits and Burdens of OCS Deepwater Activities on Selected Communities and Local Public Institutions* (GM-03-04) is the first comprehensive example and *Gulf Coast Communities and the Fabrication and Shipbuilding Industry: A Comparative Study* (GM-06-03) is the last published example that attempt model affecting agents and their effects across multiple communities. Based on a review of the large body of BOEM baseline research, we have

determined to forgo, at this stage, a search for a set of shared causal factors and, instead, to address, in detail, areas that have been impacted by petroleum development, identifying the causes and outcomes in those areas and using comparisons as appropriate as controls and as clarification. In FY 2016, the GOMR is sponsoring a study that examines spatial variability of multiple social measures coastal Louisiana parishes from the 1950 to 2010, to explore when, where, and to what degree any such measures respond meaningfully to natural or man-induced events. This study will also identify two coastal BOEM impact areas that are highly involved with OCS-petroleum and analyze them in detail.

Just as the FY 2016 study provides descriptions and assessment methods for two rural impact areas and analytical approaches for rural assessments more generally, the Houston/New Orleans effort extends this effort to the urban scene. A major topic in the findings of the MMS-sponsored 2004 workshop (McKay and Nides, 2005) on socioeconomic issues for the GOMR was the lack of information on the socioeconomic effects of offshore oil and gas activities on urban communities. Economic and social effects of OCS activities primarily occur in urban areas. Much of the related employment is concentrated in large metropolitan areas. Yet, MMS/BOEM studies have basically ignored such areas, having assumed that large city populations diffuse any socioeconomic effects so they are not as significant as those in small, rural communities.

Yet, the dynamics of the industry imply otherwise. The GOM offshore petroleum industry has been undergoing almost continuous reorganization since the oil price bust of the mid-1980s through such processes as merges, acquisitions, joint ventures, downsizing, outsourcing, new bookkeeping and cost control procedures, and technological efficiencies. The industry move into the deepwater GOM and its continuing globalization seem to reinforce its reorganizational trends. In the GOM, one significant outcome of these changes has been the concentration of more of the industry in Texas, particularly in the Houston area, at the expense of New Orleans and such smaller centers as Lafayette, Louisiana. The analysis of the changes to industry sectors that were causes and adjustments to these shifts, will further an understanding of the Houston and New Orleans impact areas, and also those of overall industry dynamics. These changes are also clearly related to other socioeconomic impacts, such as long-term low income growth in New Orleans or the recent spike in unemployment in Houston

**Objectives:** This study will provide an analysis of the two largest GOMR impact areas, a method to assess them, and insight on strategies to assess socioeconomic effects to large communities generally.

**Methods:** This project is historical and comparative. Beyond documentation, description, and statistical analyses, the project will use comparative approaches to illustrate similarities and differences between the development of Houston and New Orleans including their suburbs, their respective roles in the surrounding environment, and the place of the petroleum in that development. While the study will look at earlier periods, such as the 1980s when oil prices boomed and collapsed, the emphasis will be on 2000 and later, and particularly after 2007 and on current conditions and the potential consequences for the future. In doing this, the analysis will address several

“standard” socioeconomic impact categories particularly relevant in examining urban effects such as community identity, shifts in the tax base, real estate markets, transportation and infrastructure, changes in residential and local business patterns, and schools and education. This effort will include the collection and analysis of standard economic data that used by BOEM in its MAGPLAN economic modeling.

This effort should not reinvent the wheel. Much excellent secondary literature (*e.g.*, books, monographs, government reports) exists that addresses the topics to be addressed and a primary method will be to identify, assimilate and synthesize existing work along with other standard forms of literature synthesis (*e.g.*, of grey literature, newspaper, magazine and trade journal articles) and standard data sources.

However, while primarily based on the collection and analysis of existing primary and secondary literature and data, other methods such as discussions with key industry and community experts and representatives will be appropriate when addressing particular research questions. For example, the analysis might address the question of Houston’s locational advantages compared to New Orleans (and oil centers elsewhere in the world) using the literature review, existing data and discussions with knowledgeable individuals. It could then use these materials to identify the specific factors (*e.g.*, transportation, available services) that encouraged decisions to locate in the Houston area and analyze the role that changes in the industry had in creating or emphasizing these factors.

## **References:**

Luton, H. and R. Cluck. 2004. Social impact assessment and offshore oil and gas in the Gulf of Mexico. In *Proceedings of the 24th Annual Conference of the International Association of Impact Assessment, Vancouver Canada- 2004*. Fargo, ND: International Association of Impact Assessment. CD-ROM or published at [www.iaia.org](http://www.iaia.org).

McKay, M., and J. Nides. 2005. *Workshop on socioeconomic research issues for the Gulf of Mexico OCS Region*. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region: New Orleans, LA. MMS 2005-016.

National Research Council. 1992. *Assessment of the U.S. Outer Continental Shelf Environmental Studies Program: III. Social and Economic Studies* (Washington D.C.: National Academies Press), app. C, 111. - See more at: <http://www.eoearth.org/view/article/165542/#sthash.Zz0GcJdH.dpuf>.

**Revised Date:** March 23, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico, Western Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** OCS-Related Transportation Infrastructure in Louisiana and Texas

**BOEM Information Need(s) to be Addressed:** Analyses of onshore, OCS-related support infrastructure and associated activities and industries are a basic part of GOMR socioeconomic assessment. To date, BOEM has documented and mapped many major types of this onshore support system (*e.g.*, ports, fabrication, ship and pipeyards, heliports, refineries, *etc.*) and has described, as well, the industries, types of activities, and scale of these activities that are associated with each infrastructure type. Transportation is an important missing piece of GOMR infrastructure analyses, not only because it is a very large piece; but, even more, because it links many other pieces of the system together and with the greater U.S. The analyses of GOMR infrastructure supports scenario development for all Headquarters and GOMR environmental assessments and supports IMPLAN modeling for the Atlantic region and GOMR. This new information will support the “Impacts to Infrastructure” section of GOMR EISs, a major part of the Region’s socioeconomic assessments, and provide support for the Gulf’s environmental justice analysis Coastal Zone Management (CZM) consistency determination.

**Approx. Cost:** (in thousands) \$325

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** While OCS activities occur offshore, its social and economic consequences occur onshore. Many of these are associated with onshore infrastructure used to support offshore petroleum exploration, development and use. A great deal of BOEM socioeconomic research has focused on documenting and mapping the major types of OCS onshore support infrastructure, such as ports, fabrication, ship and pipeyards, heliports, and refineries, that comprise this system of onshore support, and on describing and documenting the industries and activities associated with each of these infrastructure types. In the case of ports and heliports, this has included efforts to describe and document travel to and from offshore platforms. BOEM continues to update, extend, and refine its analyses of this linked-together, dynamic, changeable system of things and activities, because, for much of the coastal Gulf, this is the offshore industry and the source of its positive and negative effects.

While BOEM’s efforts have encompassed transportation systems that link shore to the OCS, they have not systematically addressed the onshore transportation web: the roads, railroads and waterways used in support of OCS-related activities. These systems, too, are critical to OCS activities, and the associated support sectors and activities are substantial inputs to the social and economic consequences of the Leasing Program. The inshore transportation system supports OCS activities by allowing the movement of products among intermediate consumers (*e.g.*, from a factory to platform fabricator)

and to the final consumers. Because of the substantial demand for goods generated by OCS-related activities, inshore OCS-related transportation sectors, most notably the trucking sector, are also large. Many offshore workers commute long distances to work, which generates additional demands on transportation infrastructures. Much of this OCS-related activity is “intermodal;” equipment, materials, supplies, and people are brought to coastal areas by road, railroad, or waterway and then, are moved offshore after being transferred to a different mode of transportation at ports and heliports or transformed into vessels and platforms in fabrication and shipyards. Just as the onshore side of this system raises assessment issues, the land side does as well, often due just to the scale of the demand and the fact that transportation infrastructure may have its types of socioeconomic problems, some of which may become more pressing as deepwater developments continue to concentrate support-related activities into fewer ports.

**Objectives:** The transportation system supporting the offshore petroleum industry is intermodal. The objective of this study seeks to understand the shore-side part of this intermodal transportation system, specifically, three of its commercial elements:

- transportation by truck
- transportation by water
- transportation by rail

For each of these commercial elements, it seeks a clear picture of the system in terms of economic sectors—that is, the industries involved.

For each of these commercial elements, it seeks a clear picture of the system in terms of its geography—that is, the flows of traffic.

**Methods:** This study will describe the industry sectors associated with each of the three transportation types in terms of organization, size, employment, industry trends, relationship to the Gulf petroleum industry and offshore oil. This study will identify and map the major on-shore transportation routes used for offshore support including highways and key road connections, railroad trunk lines and key service spurs, and canals and other waterways. When appropriate, it will estimate levels of use for components of the systems. For each type of infrastructure, it will identify the various choke points (places where the transportation system is limited and/or the demands on it are high) where offshore has caused problems (*e.g.*, LA 1). Primary and secondary information will be collected from a wide range of sources including: federal and state government databases, media and trade press publications, commercial sources, and other industry-related information such as trade association-specific publications and press announcements. The study will collect economic data appropriate for use in the BOEM MAGPLAN model.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** Supplemental Data Collection of GOM Marine Mammals using Citizen Science

**BOEM Information Need(s) to be Addressed:** The GOMR manages the responsible development of oil and gas on the OCS in the northern GOM that includes coastal and offshore activities. Impacts to the environment are evaluated through the NEPA process and minimized to the maximum extent practicable. All marine mammals are protected under the Marine Mammal Protection Act or the Endangered Species Act if federally listed as threatened or endangered. In July 2015, a Memorandum was issued by the Office of Science and Technology Policy and Office of Management and Budget that encouraged Federal Agencies to foster Citizen Science opportunities.

**Approx. Cost:** (in thousands) \$150

**Period of Performance:** FY 2018–2019

### **Description:**

Background: Citizen Science encourages members of the public to voluntarily participate in the scientific process. Whether by asking questions, making observations, conducting experiments, collecting data, or developing low-cost technologies and open-source code, the public can help advance scientific knowledge and benefit society. This project would lead into future projects that could expand into the Atlantic Region and include a wide array of information that could be collected from individuals using the OCS such as commercial and recreational fishers, oil and gas workers and shipping industry workers. By encouraging citizen participation in reporting sightings, it allows the public to connect with offshore wildlife and encourages participation that will lead to a better understanding of coastal and offshore ecosystems and conservation efforts.

Objectives: This study will provide an opportunity to obtain information on marine mammals in the GOM and record observations that may otherwise be dismissed. It will also provide educational opportunities and momentum for positive relationships between the public and BOEM.

Methods: This project will have a strong component of outreach to promote voluntary data collection by citizens that encounter marine mammals in OCS or coastal waters. Electronic applications such as Whale Alert has been used in the Atlantic and Pacific providing species identification tools and a platform to enter sightings of live or distressed whales; this application will be modified. Photographs can also be included for confirmation of species identification and potentially individual animal identification. The data are managed by OBIS-SEAMAP which allows access as needed for compliance/environmental analyses. Once the public has been informed, the project can expand to provide coverage of other rare or protected species.

**Revised Date:** January 26, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 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) \$100

**Period of Performance:** FY 2018–2019

### **Description:**

Background: In 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 the rig may be historically significant for its construction techniques and design. The Coast Guard's accident investigation recommended significant changes to offshore drilling safety regulations, including blowout prevention, fire and water containment, and emergency response protocols. The accident reportedly also led directly to the development of the totally enclosed and motorized survival craft that are still in use today. Finally, the *C.P. Baker* 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.

In the mid-1950s oil companies began experimenting with mounting drilling derricks directly onto ship hulls, creating floating and fully mobile offshore drilling platforms. This marked a significant advance in drilling technology, allowing for steadily deeper water drilling capabilities for the industry, as well as introducing dynamic positioning systems, which are still integral to deepwater operations today. The majority of drilling rigs using surplus World War II Navy vessels were single-hulled ships; *C.P. Baker* was the first and perhaps only of its kind to use two hulls in a catamaran design. To BOEM's knowledge, *C.P. Baker* is the only remaining example of this era of offshore drilling rig construction utilizing surplus World War II Navy hulls. It represents a time when significant technological advancements were being made in offshore drilling technology, and also serves as an example of the adaptive use of military craft over time, and the practice of repurposing older, out-of-service vessels for modern economic functions. Considering the age of *C.P. Baker* and its components, and its place in the history of offshore oil drilling technology, safety regulation, and vessel design and use as described above, the archaeological remains of the shipwreck are potentially eligible for listing on the NRHP.

The remains of *C.P. Baker* were located in approximately 180 feet of water during a 2013 archaeological remote sensing survey conducted in association with a structure removal application. This depth is beyond the range of BOEM diver training, but is well within the operational and technical 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. That 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), 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 archaeological investigation of the wreck of *C.P. Baker* for purposes of documenting and assessing its NRHP eligibility.

**Methods:** This study will be an Interagency Agreement with NOAA. 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 and NRHP assessment. This assessment will include a report on the history of the vessel and aftermath of its sinking, its significance in the development of offshore oil drilling activities, and a thorough documentation of its archaeological remains including a detailed site map, assessment of its structural integrity and state of preservation, and photo/video documentation. An oral history of the incident may be included if any survivors or descendants of the victims can be identified. If determined eligible, National Register nomination forms will be prepared and submitted 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 Memorandum of Understanding with NOAA's Monitor National Marine Sanctuary) will collect underwater photo/video imagery, including postproduction of each for report documentation and public outreach purposes.

Additional public outreach materials will be produced to highlight *C.P. Baker's* significance in the history of offshore drilling technology, 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. The Ocean Star Drilling Rig and Museum in Galveston, Texas, has indicated a preliminary interest in hosting a museum display dedicated to this project.

**Revised Date:** January 26, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Western Gulf of Mexico, Central Gulf of Mexico, and 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 the development of a more regionalized and detailed socioeconomic impact analysis. BOEM’s economic impact model, MAGPLAN will benefit from much needed improved estimates of lease sale-driven employment and population impacts, including the consideration of the function of additional lease sale-related labor demand within an OCS industry experiencing declining labor demand overall.

**Approx. Cost:** (in thousands) \$350

**Period of Performance:** FY 2018–2022

### **Description:**

**Background:** The petroleum industry has played a major role in the Gulf for more than one hundred years, the offshore industry for more than 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 SIA, leading to issues of growth and decline, benefits and burdens, social change and conflict.

**Objectives:** 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 has 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?

**Methods:** 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 methodology that will be developed as a result of this study will be designed in recognition of the specific problem that for social impact assessment, 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. Specifically, the questions of sale-level labor demand, new *vs.* continuing employment, and in-migration have not been addressed successfully yet by BOEM.

The industry is an integral part of the Gulf's economy and society, that is spread ever where, 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, this profile offers a hierarchical approach as a framework for study researchers. 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 another date). More effort necessarily goes into the top than the bottom.

The successful proposal will present a set of research questions and methodologies aimed at a coherent view of demographic consequences over space and time. These methods may include literature review, primary or secondary data collection and analyses, individual interviews, and model development, for example. A Quality Review Board with members who operate as individual advisors will be established to provide BOEM with demographic expertise in overseeing study progress and reviewing its results.

**Revised Date:** March 25, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico OCS Region

**Title:** Gulf of Mexico Deepwater Ecosystem Observatory Network (GODEON) – 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 GOM offshore waters to address the potential impacts of oil and gas activities. This study will establish an ecosystem observatory network in GOM deep waters to provide a long-term monitoring capability for assessing trends in marine health and productivity, to help meet BOEM’s mandates under the Outer Continental Shelf Land Act and other laws. Biological data on marine mammal, sea turtle, fish, and plankton distributions and habitat use, as well as ambient noise, are required for EFH and ESA consultations, in addition to MMPA Rulemaking.

**Approx. Cost:** (in thousands) \$5,000      **Period of Performance:** FY 2018–2022

### **Description:**

Background: Since the *Deepwater Horizon (DWH)* oil spill, there has been a concerted effort within the Gulf community to expand and enhance long-term environmental monitoring capabilities for better characterizing status and trends in marine health and productivity. A recent Ocean Conservancy report (Love *et al.*, 2015) provided a gap analysis for existing Gulf monitoring programs for species and habitat injured during the *DWH* spill. The report highlighted the rare and disjointed nature of offshore monitoring and advocated for moving towards a Gulf-wide ecosystem monitoring network. In particular, monitoring was documented as limited and fragmented for marine mammals and marine fish and often absent for sea turtles. The ocean observing system was characterized as sparse or inoperative in offshore waters for monitoring of physicochemical drivers required for understanding ecosystem change.

Fortunately, technologies and roadmaps exist for development of offshore ecosystem-based observing systems in the GOM. For example, BOEM has contributed actively to the Gulf of Mexico Coastal Ocean Observing System (GCOOS) Build-Out Plan Version 2, which contains an ecosystem monitoring component. This plan includes a strategic framework for integrating instrumentation onto both fixed (*e.g.*, mooring networks) and mobile (*e.g.*, gliders, autonomous vehicles, animal tagging) platforms in the GOM for the year-round, long-term measurement of living marine resources and habitat. A hybrid, multi-platform approach is recommended for optimal spatio-temporal coverage, including use of hydrophones for marine mammal detection, acoustic receivers for tagged animals, multi-frequency acoustic backscatter systems for detecting fish and zooplankton, and instrumentation for a variety of physicochemical parameters.

**Objectives:** The objective of this study is to provide long-term biological and physical time series data in offshore waters to improve understanding of living marine resources and potential impacts from both natural and anthropogenic stressors, including oil and gas activities and associated seismic surveys.

**Methods:** This study will expand observing capabilities for year-round, multi-year ecosystem monitoring in deep waters of the GOM. It is anticipated that the objectives of this study will be met through a hybrid, multi-platform approach using fixed moorings, mobile assets, and animal telemetry devices to broadly cover northern Gulf deep waters and provide time-series of biological and physiochemical data at strategic locations. This study will be coordinated closely with related studies, including the *Passive Acoustic Monitoring (PAM)* and *Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS)* Studies in the GOM, and the related *Atlantic Deepwater Ecosystem Observatory Network (ADEON)* Study. Consideration will be given to the best available ocean observing technologies for measuring marine animal distributions, densities, and prey fields, including both passive and active acoustic systems. The existing network of tagged animals in the Gulf (such as through iTAG) will be augmented with additional tags to better include deepwater species of interest, for detection by the acoustic receivers planned for the observing system. Regular ship-based support will provide mooring and autonomous vehicle deployment, validation sampling, and instrumentation maintenance. Finally, time series analyses will be performed for all measured parameters to inform spatially-explicit density distribution models and provide a mechanistic understanding of forcing factors (*e.g.*, natural versus anthropogenic) driving variability.

Co-sponsorships will be sought with other programs that share common goals of the study. The GODEON system will be operated in synergy with other ocean observing assets in the GOM to complement and leverage the existing backbone of regional monitoring. Ultimately, funding will be sought beyond the current study to ensure that the network supports long-term environmental monitoring in Gulf offshore waters to inform BOEM's needs for understanding environmental trends and the potential impacts of the oil and gas activities it regulates.

#### **References:**

Love, M., Baldera, A., Robbins, C., Spies, R.B. and Allen, J.R. 2015. *Charting the Gulf: Analyzing the gaps in long-term monitoring of the Gulf of Mexico*. New Orleans, LA: Ocean Conservancy.

**Revised Date:** January 14, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Eastern Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** Identification and Modeling of Wooden Shipwreck  
Remains in Pensacola Bay, Florida

**BOEM Information Need(s) to be Addressed:** BOEM needs to improve its survey requirements so historic sites such as wooden shipwrecks, which lose their relief more quickly, can be more readily detected. This category of shipwreck is often among the most difficult to detect due to their comparative rate of degradation when exposed above the seafloor. Given the increase in nearshore activities related to oil- and gas production structure removals, new and decommissioning pipelines, and extraordinary levels of vessel traffic, BOEM needs to have adequate planning and information ready for the very real possibility of both onshore and offshore infrastructure changes that may divert operations toward the Eastern GOM, as well as improve our ability to protect difficult to detect resources surrounding ongoing operations in the Central and Western Gulf. The results of the study will support the State of Florida, which has requested BOEM to assist with a more robust survey and inventory of resources in the area but also BOEM's current strategies for the detection and inventory of these significant resources. The study will also proactively address BOEM's NHPA and NEPA responsibilities for Gulf-wide shallow water activities including potential expansion into the Eastern GOM.

**Approx. Cost:** (in thousands) \$275

**Period of Performance:** FY 2018–2022

### **Description:**

**Background:** Pensacola Bay, Florida contains two wooden shipwrecks that are among the oldest ever found in the GOM. This provides a test-bed and opportunity for BOEM to refine its archaeological survey methodologies and management strategies for shallow water sites which are environmentally similar to nearshore areas on the OCS. There are four more 16<sup>th</sup> century Spanish shipwrecks yet undiscovered in Pensacola Bay, which the State of Florida's Bureau of Archaeological Research and State Archaeologist have indicated as their top research priority for the Gulf portion of their State.

Since the Eastern GOM has had little-to-no oil and gas development, Pensacola Bay serves as an ideal test-bed location for evaluating and refining detection methodologies without potential confounding of materials or debris from oil and gas operations. Also, if a new site discovery was made while BOEM was conducting survey work, the Bureau would be credited with assisting in the discovery of some of the oldest shipwreck remains in American waters, which would help facilitate relationship-building among Eastern Gulf States and function as a demonstrated commitment to support their research interests. This study is recommended for funding through a cooperative agreement and the Gulf Coast Cooperative Ecosystems Studies Unit to reduce overhead and leverage resource sharing like survey vessels and geophysical equipment which will be needed for this survey project.

**Objectives:**

The study's objective is the survey and analysis of wooden shipwreck remains to assess BOEM's shallow water survey methodologies in the GOM while providing the State of Florida requested assistance in the search for the missing Spanish colonization fleet of 1559.

**Methods:** Traditional and advanced archaeological site detection methodologies will be examined on several known wooden shipwrecks in Pensacola Bay. Test, evaluate, and refine (if necessary) BOEM's shallow water wooden shipwreck detection and identification methodologies. The study will use a variety of geophysical instrumentation commonly used in the GOM for the detection of wooden shipwreck remains. The study will also survey high-probability areas for the location of the missing four shipwrecks from the Spanish colonization attempt of 1559 and may also include limited target diving and evaluation of anomalies. The final report will recommend methodologies and establish best practice guidelines, specifically targeting the detection and evaluation of wooden shipwrecks from various time periods and preservation levels. Pensacola has many wooden shipwrecks that would be an ideal survey methods test-bed. They will also search recent literature and publications on the matter to inform the final report.

**Revised Date:** January 11, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

Administered By: Gulf of Mexico OCS Region

Title: Cabled Observatory Feasibility Study Using the Gulf of Mexico Fiber Optic Network for Long-Term Ecosystem Monitoring in Offshore Waters

**BOEM Information Need(s) to be Addressed:** BOEM requires long-term monitoring information in offshore waters to quantify changes in marine ecosystem quality and productivity potentially caused by oil and gas activities, including Geological & Geophysical (G&G) seismic surveys. Year-round, time-series information is required to understand status and trends for a variety of living marine resources, including marine mammals, fish, plankton, and deep sea corals, as well as habitat conditions to inform environmental assessments in NEPA documents, ESA and EFH consultations, and MMPA rulemaking. Understanding how a Gulf cabled observatory network could contribute to an expanded offshore observing system would help advance BOEM's ability to strategically plan long-term monitoring activities in the GOM.

**Approx. Cost:** (in thousands) \$350      **Period of Performance:** FY 2018–2020

### **Description:**

**Background:** Development of a marine cabled observatory for environmental monitoring has been of interest for several years in the Gulf community (*e.g.*, Murawski and Hogarth, 2013). The unique strength of utilizing the GOM Fiber Optic Network (FON) backbone ([www.bpgomfiber.com](http://www.bpgomfiber.com)) is that it can both provide high-speed, real-time communications to proposed observatory nodes and access power from the oil and gas platforms connected to the network. While the concept of cabled observatories has not been thoroughly explored in the GOM, such observatories have successfully provided long-term environmental time series in other regions, including the LEO-15 program off New Jersey, the VENUS and NEPTUNE cabled observatories in Canada, and now as a component of NSF's Ocean Observing Initiative. Observatory instrumentation at these sites has included hydrophones for ambient noise and marine mammal vocalizations, multi-frequency acoustic backscatter systems for detecting fish and zooplankton, 3-D cameras for observing underwater habitat, acoustic receivers for tracking tagged animals, physical oceanographic equipment for ocean currents and conductivity/temperature/depth, and water quality instrumentation, including for pH, CO<sub>2</sub>, and chlorophyll. Past experience at these sites has demonstrated the expandability of cabled observatory nodes to add new instrumentation over time for achieving evolving science aims.

**Objectives:** The goal of this study is to provide a feasibility assessment for developing observatory nodes on the GOM FON to provide long-term biological and physico-chemical time series in offshore waters.

**Methods:** A detailed feasibility study would be performed to assess the potential for developing a Gulf cabled observatory network through consideration of implementation logistics (including coordination with industry), ability to meet BOEM and community science goals, and an economic analysis for establishing and maintaining the observatories over the long term. Specifically, an assessment would be made to determine optimal science locations for developing nodes along the cable, informed by a workshop to determine Gulf community science needs (including those of potential partners) for long-term monitoring of living marine resources and habitat in offshore waters. This feasibility assessment would additionally determine exact locations of power and fiber connection points, cable routing options, appropriate instrumentation to include at each node, and expenses for the initial infrastructure (capital) and annual operating costs. At a minimum, BOEM's requirements for instrumentation at these observatories is expected to include hydrophones for ambient noise and marine mammal density estimates, various acoustical systems for detecting fish, plankton, and possibly tagged animals, and habitat measurements for modeling population dynamics and understanding environmental drivers of long-term changes.

**Revised Date:** January 14, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Central Gulf of Mexico

**Administered By:** Gulf of Mexico OCS Region

**Title:** The Visual Impacts of OCS activities on Horn and Petit Bois Islands

**BOEM Information Need(s) to be Addressed:** This study will evaluate the visual impacts that could result from OCS oil and gas activities near Horn and Petit Bois Islands, which are part of the Mississippi District of the Gulf Islands National Seashore (GUIS). These potential impacts include the visibility of platforms (during day and night), and the visibility of OCS vessel traffic. This information would be used in future EISs to meet requirements of the NEPA, particularly in light of recent participation by the National Park Service (NPS) in BOEM EISs.

**Approx. Cost:** (in thousands) \$250

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** The GUIS consists of two mainland portions and four barrier island portions in the northwest Florida panhandle, and a mainland section and six barrier islands in Mississippi. In 1978, Horn and Petit Bois Islands in the Mississippi District of the GUIS were designated by the U.S. Congress as having Wilderness status. This status reflects the pristine and undeveloped nature of these islands that are important to island visitors. OCS structures have existed close to these islands. Most of these have been removed; a few structures remain 7–10 miles away. The NPS, while participating as a Cooperating Agency for recent Lease Sale EISs, has raised concerns regarding the potential visual impacts from OCS activities on Horn and Petit Bois Islands. For example, NPS is concerned about the impacts of platform lighting on the visual experiences of these islands at night. No prior studies have analyzed the impacts of the historical OCS structures near Horn and Petit Bois Islands on visitor experiences. BOEM has done some work regarding the potential visual impacts of renewable energy facilities in the Atlantic Ocean. For example, an ongoing BOEM study is developing a computer tool to simulate the viewsheds arising from various potential Atlantic energy facilities.

**Objectives:** The objectives of the study are to:

- Determine the visual impacts arising from existing OCS activities near GUIS. This includes impacts from platforms, lighting, and vessel traffic
- Determine the visual impacts that could arise from future OCS leases
- Identify cumulative visual impacts to GUIS. For example, there is a high amount of non-OCS vessel traffic near GUIS.
- Identify possible measures to mitigate impacts

**Methods:** There are various potential methods to address the objectives of this study. The ultimate methods chosen will depend on budget constraints, the availability of the required information, and the trade-offs these methods offer. Some potential techniques to estimate the visual impacts to GUIS from OCS and non-OCS sources are:

- Photographic and video analysis of platforms in the vicinity of GUIS
- Background research and simulation analysis of the impacts of potential future OCS structures
- Interview GUIS visitors regarding the visual impacts of current and potential future OCS structures
- Analyze existing data on vessel traffic. For example, Portvision® is a data package that provides data on historical movements of OCS and non-OCS vessel traffic. This data could provide baseline information on the visual disturbances near Horn and Petit Bois Islands. This data could also be used to forecast the visual impacts from vessel traffic that could arise from future OCS lease sales.
- Collect night sky measurements to compare anthropogenic with natural light conditions near GUIS
- Assemble a panel of experts to assess visual impacts, as well as potential mitigation measures

The results from these methodologies will be synthesized into a report that puts the visual impacts from current and potential future OCS activities in context, and identifies potential mitigation measures for BOEM's consideration.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Southern California

**Administered By:** Pacific OCS Region

**Title:** Seabird and Marine Mammal Surveys Near Potential Renewable Energy Sites Offshore Central and Southern California

**BOEM Information Need(s) to be Addressed:** With recent interest from the renewable energy industry in leasing areas for wind and wave energy developments offshore central and southern California, BOEM will need to update information on the distribution and abundance of sensitive resources in these Planning Areas, including seabirds and marine mammals. The proposed study will be designed to provide up-to-date information on species composition, distribution, abundance, and seasonal variation of seabirds from the southern limit of the Monterey Bay National Marine Sanctuary to the U.S.-Mexico border. In addition, data will be opportunistically collected on marine mammals that are observed during the surveys. Data generated will be used for environmental review of renewable energy projects proposed in this area, including those under the National Environmental Policy Act and Endangered Species Act.

**Approx. Cost:** (in thousands) \$2,000      **Period of Performance:** FY 2017–2020

### **Description:**

**Background:** The Southern California Bight and the central coast of California provide habitat for numerous seabird species. More than 20 species of seabirds breed in this region, primarily on the Channel Islands. This is the only region in California supporting breeding Black Storm-Petrels (*Oceanodroma melania*), Brown Pelicans (*Pelecanus occidentalis*), Scripps's Murrelets (*Synthliboramphus scrippsi*), and Elegant Terns (*Thalasseus elegans*). The area also contains nearly half of the world population of Ashy Storm-Petrels (*Oceanodroma homochroa*). In addition, numerous seabirds migrate through or winter in this region.

Several project proponents are interested in developing renewable energy projects (both wind and wave) in this region, including a commercial-scale wind project off of Morro Bay. The installation and operation of renewable energy devices at sea has the potential to affect seabirds and marine mammals. Activities that can have effects on these species include construction and operational activities, vessel traffic, seismic surveys, foundation and cable installation, turbine operation, foundation protection, and cables. Resulting effects include collision and entanglement, prey base and habitat alteration, displacement, movement barriers, EMF effects, light attraction, pollution, and noise impacts.

The Bureau of Land Management (BLM) and the Minerals Management Service (MMS) funded seabird and marine mammal surveys in the Southern California Bight in 1975–1978 (Briggs, *et al.* 1981), in central and northern California in 1980–1983 (Dohl, *et al.*

1983), and in southern and central California in 1999–2002 (Mason, *et al.* 2007). While these surveys provide a good foundation of information for the area, they should be updated given the shifts of species' distribution and abundance that may have occurred over the past four decades. The proposed study would repeat and refine the methodology used in earlier studies to provide up-to-date information and establish a more robust longitudinal data set from which to draw on for environmental analyses. The results will include digital raster maps of species distributions within state and federal waters. Results will be provided in scientific presentations, peer reviewed scientific papers, and in a readily accessible, comprehensive marine GIS package.

**Objectives:** Objectives of this study are: 1) Update BOEM's understanding of the status and distribution of seabirds and marine mammals in areas off the coast of central and southern California where renewable energy projects may be proposed; and 2) Relate this new information to that collected by other surveys on this portion of the Pacific OCS over the last 40 years.

**Methods:** Seasonal aerial surveys offshore central and southern California would be conducted over a 2 to 3-year period. These surveys would be designed to match those flown in the previous studies mentioned above along historical transect lines between Cambria (35° 35' N) and the U.S-Mexico border (32° 32' N). In addition, finer-scale focal areas would be established and surveyed in areas where there is a higher potential of renewable energy project development, including the Santa Rosa Flats, offshore of Morro Bay, offshore of Vandenberg Air Force Base, the western Santa Barbara Channel, and any other areas identified by BOEM. The surveys would characterize the current diversity, distribution, and abundance of seabirds and marine mammals within the study area at a scale that is useful for assessment of renewable energy proposals. Survey methodologies used in previous studies would be reviewed and modified, as necessary, to account for new technologies and equipment availability. A potential complement to this survey effort would be the use of other technologies, such as horizontal and vertical avian radar, to survey spring and fall cross-shelf migration windows in the California Current.

The proposed study would include seasonal aerial surveys along prescribed transect lines supplemented by other sources of aerial/shipboard data collected over the past 40 years, as available. Previously collected data would be assessed and analyzed to allow for comparisons with the newly collected data to identify changes in distribution and abundance of seabirds over the last 40 years.

## **References:**

Briggs, K.T., E.W. Chu, D.B. Lewis, W.B. Tyler, R.L. Pitman, and G.L. Hunt, Jr. 1981. Distribution, numbers and seasonal status of seabirds of the Southern California Bight Area, 1975-1978. Summary of marine mammal and seabird surveys of the Southern California Bight Area, 1975-1978, Vol. III. Investigators Reports, Part III: Seabirds, Book I, Chapter I. U.S. Department of the Interior, Bureau of Land Management: BLM/YN/SR-81-03. 337 p.

Dohl, T.P., M.L. Bonnell, R.C. Guess, and K.T. Briggs. 1983. Marine mammals and seabirds of central and northern California, 1980-1983: Executive summary. U.S. Department of the Interior, Minerals Management Service: OCS Study MMS 84-0041. 29 p.

Mason, J.W., G.J. McChesney, W.R. McIver, H.R. Carter, J.Y. Takekawa, R.T. Golightly, J.T. Ackerman, D.L. Orthmeyer, W.M. Perry, J.L. Yee, M.O. Pierson, and M.D. McCrary. 2007. At-Sea Distribution and Abundance of Seabirds Off Southern California: A 20-Year Comparison. *Studies in Avian Biology* 33:1-95.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Southern California

**Administered By:** Pacific OCS Region

**Title:** Exploration and Research for California Coastal and Ocean Renewable Energy (Cal CORE) I: Data Synthesis, Mapping, and Analyses

**BOEM Information Need(s) to be Addressed:** The Pacific Region received an application for a commercial lease of 100+ turbines within an area of about 200 square miles using floating wind energy conversion devices offshore south-central California. The general ecology of the shoreline/beach and nearshore kelp bed areas of south-central California has been characterized. However, farther offshore the oceanic area of interest, 20–35 miles, 500–1000 m water depth, on the continental slope remains an unmapped and unstudied expanse. Specifically, mapping and sampling of slope and canyon communities as well as exploration for other areas of potential significance is needed for informed decisions regarding potential wind turbine siting, distribution of habitats and historic sites, and the sensitivity of associated biological communities to impacts. The results of this study will help to define mitigations and identify hard bottom areas, archaeological sites, and any associated sensitive deep shelf and slope communities that energy development should avoid. Results will be used in potential NEPA documents and to fulfill consultation and analysis requirements under the Migratory Bird Treaty Act, Magnuson-Stevens Fisheries Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act for a wind energy commercial lease off south-central California.

**Approx. Cost:** (in thousands) \$1,500      **Period of Performance:** FY 2017–2019

### **Description:**

**Background:** Dynegy retired an obsolete power plant located on the shore at Morro Bay, but retained the fully operational connection to the California electrical utility. The grid connection is sufficient to flow the proposed Trident Winds' and/or other wind energy facilities' electrical production at maximum capacity into the California Central-Valley electrical backbone. Trident Winds and other potential wind energy generating companies are discussing potential paths to power purchasing from offshore wind with the California Energy Commission. California's Governor has set a goal to meet 50% of the state's energy needs with clean, renewable energy by 2030. Offshore wind power is set to play an important role in meeting this goal. This offshore area may prove to be a region of competitive interest for renewable energy.

Early studies from the late 1970s and through the early 1980s were completed in locations both south and north of the area of interest, where oil and gas potential existed. Those studies were 60–80 miles away from the area of interest and did not include the region directly offshore San Luis Obispo County and the coastal city of Morro Bay. Thus, there are no geophysical or surface anomaly maps or habitat characterizations for the area of interest. Other areas that were surveyed prior to oil and

gas leasing off California, in the general bathymetric range of 300–1000 m, documented hard bottom reefs, potential archaeological and shipwreck sites, and canyon areas that included significant boulders and rock outcrops, some with high relief and a high diversity of associated attached communities (Hixon, Tissot, and Pearcy 1991). The offshore habitats nearest to the area of interest that have been mapped include significant populations of both low and high-relief hard bottom reefs, corals, gorgonians, and canyon/canyon-wall habitats (Greene, *et al.* 2003). Gross bathymetry of the Cal CORE study area suggests depth changes within the 300–1000 m range that could support similar habitats. Megafauna associated with slope reefs and canyons are different and more diverse than on surrounding continental slope habitats (Huff, *et al.* 2013). The *Cal CORE I: Data Synthesis, Mapping, and Analyses* study is the first step in the process to define mitigations and identify hard bottom areas, archaeological sites, potential shallow hazards, and any associated sensitive deep shelf and slope communities that energy development should avoid.

**Objectives:** The goal of Cal CORE is to explore and characterize the continental deep shelf and slope offshore south-central California in anticipation of commercial wind energy installations. Specific objectives are as follows:

- To gather data and define the footprint area for exploration and plan mapping and surveying
- To map and geo-reference the footprint using high-resolution multibeam surveying and sub-bottom profiling
- To analyze mapped data in order to characterize possible geo-habitats, potential shallow hazards, and choose and refine target locations for further study and/or delineate as potential avoidance areas

**Methods:** This project will require the use of sophisticated submerged instrumentation capable of high-resolution bottom imagery and sub-bottom profiling at depths of 500–1000 m. This could include ship-based devices or autonomous underwater vehicles (AUVs) or towed fish for mapping. Large-scale mapping will be required to define substrate type and distribution of potential hard bottoms associated with canyons as well as more distinct slope areas. Attempts will be made to partner with USGS and potentially NOAA for surveys, sediment study, physical oceanography, submerged instrumentation, and research vessel facilities for all or part of the efforts.

### **References:**

- Greene, H.G., J.J. Bizzarro, D.M. Erdey, H. Lopez, L. Murai, S. Watt, and J. Tilden. 2003. Essential fish habitat characterization and mapping of California continental margin. Moss Landing Marine Laboratories Technical Publication Series No. 2003-01, 29 p., 2 +CDs.
- Hixon, M.A., B.N. Tissot, and W.G. Pearcy. 1991. Fish assemblages of rocky banks of the Pacific northwest, Heceta, Coquille, and Daisy Banks. U.S. Department of the Interior, Minerals Management Service. OCS Study MMS 91-0052. 410 p.

Huff, D.D., M.M. Yoklavich, M.S. Love, D.L. Watters, F. Chai, and S.T. Lindley. 2013. Environmental factors that influence the distribution, size, and biotic relationships of the Christmas tree coral *Antipathes dendrochristos* in the Southern California Bight. Marine Ecology Progress Series, Vol. 494: 159-177.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Hawai‘i

**Administered By:** Pacific OCS Region

**Title:** Atlas of Main Hawaiian Island Seabird Colonies

**BOEM Information Need(s) to be Addressed:** The Hawai‘i Clean Energy Initiative and renewable energy goals are the most aggressive in the nation, with the Governor setting the goal at 100% clean energy by 2045. In addition to land-based alternative energy, the DOI and the State of Hawai‘i have received proposals to develop commercial-scale offshore renewable energy capacity within state and federal waters surrounding the Main Hawaiian Islands (MHI). Several Hawaiian seabird species, including Endangered Hawaiian Petrels, are killed by terrestrially sited wind turbines; future turbine infrastructure at sea and marine cable-laying operations pose strike, grounding, and mortality risks to free-ranging seabirds that colonize Hawai‘i. This risk will vary according to species, time of year, and environmental conditions. Currently, BOEM, federal, state, and local resource managers lack comprehensive, quantitative data to map seabird colony locations, extents, and breeding population sizes throughout the MHI. This basic population information—compiled in previous MMS-supported seabird colony catalogues for California, Oregon, Washington, and Alaska—now is urgently needed in Hawai‘i to (1) evaluate threats to colonies and adjacent high-use offshore waters, (2) provide a reference to measure population trends, and (3) best inform place-based conservation and restoration actions.

**Approx. Cost:** (in thousands) \$900

**Period of Performance:** FY 2017–2021

### **Description:**

**Background:** The MHI (8 main islands, excluding the leeward archipelago) and numerous associated offshore islets provide substantial breeding habitat for approximately 20 seabird species; the Newell’s Shearwater, Hawaiian Petrel, and Band-rumped Storm Petrel are considered threatened or endangered by state or federal agencies. Presently, very little is known about seabird breeding population sizes and trends throughout the MHI. More than 30 years ago, the USFWS initiated a synthesis of existing information about the status of seabird populations in Hawai‘i; a review of reports and literature identified 21 species and 247 colony sites (Fefer n.d.). This effort occurred before GIS mapping and no new colony surveys were conducted in association with the synthesis. To support extensive colony-based tracking of Hawaiian seabirds (BOEM 2015a) and a comprehensive vulnerability assessment for seabirds at sea throughout the MHI (BOEM 2015b), USGS has compiled a digitized geodatabase version of the preliminary Fefer *et al.*, synthesis and has worked with more recent collaborator data (Hawai‘i State Department of Land and Natural Resources) to update site-specific species count data. A revised, comprehensive Atlas of Hawaiian Seabird Colonies is needed by BOEM to support environmental risk assessments, environmental impact statements, and pre- and post-lease decisions related to potential renewable energy leasing on the Pacific OCS surrounding Hawai‘i. This effort will provide mapped breeding distributions and contemporary reference information to increase knowledge,

build resource management capacity, and assist targeted conservation actions on land. Furthermore, this atlas will allow USGS to generate quantitative model-based predictions of at-sea distribution based on colony size and location, central-place foraging theory, and new empirical data from at-sea ranging studies throughout Hawai‘i (BOEM 2015a).

#### Objectives:

1. Update the known status of seabird colonies on the Main Hawaiian Islands.
2. Assess the effectiveness of survey protocols and other data collection approaches.
3. Determine how information on Hawaiian seabird colonies can be shared with other scientists, agencies, and stakeholders.
4. Determine how colony data can quantify and map foraging seabird distribution at sea.

**Methods:** This three-phase effort is facilitated by previous seabird colony atlases. In phase one, USGS will continue networking among main-island-based resource stakeholders (federal and state land managers, NGO partners, and private land owners) to involve existing regional expertise in a collaborative effort to concatenate the most recent colony count data into a common database and identify regional data gaps. This is imperative for a regionally comprehensive atlas because of the physical and political separation of the MHI, their resources, and stakeholders. In phase two, quantitative surveys guided by results from regional data gap analysis will be implemented to measure breeding seabird abundance, distribution, and habitat characteristics. Effective survey protocols and standardized approaches (*e.g.*, ground-based sampling for burrowing seabirds, aerial photogrammetry for surface-nesting species, acoustic and remote methods for cryptic and nocturnal species) will be developed to quantify abundance and associated habitat metrics. New aerial photogrammetry methods will be used to document and map remote and inaccessible islet sites to a fine-scale (~5 cm resolution). The resulting SQL database of seabird colonies will host count data, habitat metrics, and associated metadata (*e.g.*, sources, methods, history, introduced species, threats, *etc.*). A comprehensive and accessible GIS Atlas (geodatabase) of seabird colonies throughout the MHI and associated islets will be created and hosted online via the BOEM Marine Cadastre and USGS. New methods to generate at-sea distributions among breeding seabirds can be used to inform similar efforts to map colony-based distributions in the Pacific. In phase three, USGS will use a modeling-based approach to combine recent BOEM-supported seabird at-sea utilization data with new colony data from this atlas to generate spatially explicit, central-place-foraging-based species probability distributions (Grecian, *et al.* 2012).

#### **References:**

BOEM. 2015a. Habitat Affinities and At-sea Ranging Behaviors among Main Hawaiian Island Seabirds (PC-13-03). Last revised December 10, 2015. Bureau of Ocean Energy Management: <http://www.boem.gov/pc-13-03/>.

BOEM. 2015b. Developing and Applying a Vulnerability Index for Scaling the Possible Adverse Effects of Offshore Renewable Energy Projects on Seabirds on the Pacific OCS (PC-12-01). Last revised December 10, 2015. Bureau of Ocean Energy Management: <http://www.boem.gov/pc-12-01/>.

Fefer, S. I. Unpublished data 1983–1989. U.S. Fish and Wildlife Service.

Grecian, W.J., M.J. Witt, M.J. Attrill, M.J., S. Bearhop, B.J. Godley, D. Grémillet, K.C. Hamer, and S.C. Votier. 2012. A novel projection technique to identify important at-sea areas for seabird conservation: An example using Northern Gannets breeding in the North East Atlantic. *Biological Conservation*, 156(2012), p.43-52.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Southern California, Central California, Northern California, Washington-Oregon, Hawai‘i

**Administered By:** Pacific OCS Region

**Title:** Pacific Marine Assessment Partnership for Protected Species (PACMAPPS)

**BOEM Information Need(s) to be Addressed:** The Pacific Region continues to assess environmental effects of existing oil and gas development activities and proposed renewable energy facilities using the best available information. For marine mammals, we often rely on stock assessment reports prepared annually by the National Marine Fisheries Service (NMFS). Although these reports are prepared annually, the underlying data supporting these reports may be several years old and NMFS science center cruise schedules in the Pacific (Southwest, Northwest, and Pacific Islands Science Centers) are not necessarily coordinated across species distributions. Likewise, there is limited information on offshore distribution and use of the outer continental shelf by other protected species including seabirds and sea turtles. This study will support a Pacific-wide strategic plan for coordinated protected species assessment surveys and derived site-specific analyses relevant to BOEM areas of interest.

**Approx. Cost:** (in thousands) \$1,340      **Period of Performance:** FY 2017–2020

### **Description:**

**Background:** In 2011, BOEM and NMFS entered into a memorandum of understanding whereby both agencies agreed to cooperate and coordinate environmental studies and analyses. Collection and analysis of protected species (marine mammals, seabirds, and sea turtles) data are fundamental needs for both agencies. In 2013, the Marine Mammal Commission recommended that BOEM Pacific Region partner with other state and federal resource agencies, academic institutions, and private researchers to support broad-scale, multi-year, seasonal wildlife surveys. BOEM met with NMFS, U.S. Navy (Navy), and U.S. Fish and Wildlife (USFWS) representatives from West Coast and Pacific Islands Science Centers and regional offices on March 18, 2016. The objective was to develop a multi-year strategic plan for protected species assessment surveys across the Pacific that would address each agency’s information needs. BOEM, Navy, USFWS, and NMFS all agreed that the U.S. West Coast (California Current ecosystem) and Hawaiian Archipelago were high priority areas for protected species survey effort. The ultimate goal is to develop a partnership between our agencies and regions that will allow for better and more consistent data collection across the Pacific. BOEM’s contribution will help fill spatial and temporal gaps in current survey efforts.

**Objectives:** The purpose of this study is to provide up-to-date assessments, including spatial and temporal distribution, of protected species in areas of the Pacific that are of special interest to BOEM. Essentially, we will address the questions of where do marine mammals live in the Pacific? Why do they live there? And what factors do we look at to predict future distribution? Specific objectives include:

1. Identify oceanographic conditions that influence protected species distribution.
2. Describe how protected species distribution in the Pacific may shift with changing environmental conditions.
3. Identify geographic features that are associated or interact with key life history elements (*e.g.*, feeding, migration, breeding, and birthing).
4. Evaluate the relative importance of protected species habitat on a scale useful for the evaluation of offshore energy projects in the Pacific.
5. Archive survey data in a system that will allow current data to be compared with past and future efforts.

Collection of data across the range of species' distribution provides *context* for environmental review of offshore projects. A clear understanding of what drives species' use of marine habitats allows us to describe the relative *intensity* of interactions between protected species and offshore human activities. Both *context* and *intensity* are critical components of National Environmental Policy Act (NEPA) reviews.

**Methods:** National Oceanic and Atmospheric Administration (NOAA) vessels will conduct long-range visual and acoustic line-transect surveys for protected species and collect oceanographic data in the California Current ecosystem (Washington through California) (CY 2018) and the Hawaiian Archipelago ecosystem (CY 2017). The resulting data will be used to support up-to-date stock assessments and derived protected species use and distribution products for areas of interest to BOEM (currently portions of Oregon, central and southern California, and the Main Hawaiian Islands).

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 support staff in additional subjects, not only shoreline related work, to investigate mission-related effects that are related to cooperative agreement studies or to test new study ideas or equipment on a small scale.

**Approx. Cost:** (in thousands) \$100

**Period of Performance:** FY 2017–2021

### **Description:**

**Background:** The OCS 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) is a group of Pacific Region scientists that began monitoring rocky intertidal shores in 1991 as one of twelve teams that comprise the Multi-Agency Rocky Intertidal Network (MARINE). BOEM currently supports MARINE through a cooperative agreement (BOEM-MARINE) with the University of California, Santa Cruz. The PRISM team provides substantial government involvement to this agreement by collecting data at the 32 sites established in each of four counties bordering oil and gas platforms. Individual staff members average completion of 2-15 sites over 2-10 field days each year. However, in addition to the biannual monitoring of established rocky intertidal sites (support of MARINE), 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 studies 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 providing opportunities for BOEM scientists to interact with the public during monitoring and provides BOEM with the opportunity to visibly demonstrate our commitment to the environment.

**Objectives:** We want to expand the use of these funds beyond rocky intertidal shorelines 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 for substantial government involvement in other Pacific Region cooperative agreements, in addition to the BOEM-MARINE agreement.

- 1) Support time for Pacific Region scientists to be in the field conducting science, collecting data, or communicating with the public or other stakeholders.
- 2) Provide the tools necessary to conduct field work and analyze data. This can include purchasing or renting field equipment and or software.

**Methods:** Specific tasks will be decided at the beginning of each fiscal year and reviewed by BOEM 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 period. The second task will be to continue deployment and maintenance of a network of pH sensors in the Santa Barbara Channel with the University of California and the National Park Service. Additional tasks are either special short-term studies designed by staff to answer specific questions or efforts which support the monitoring task. Examples of the range of topics pursued by the PRISM team in the past 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. The PRISM team has also begun to investigate how our existing field efforts can inform environmental analyses of future lease sales for renewable energy projects. Offshore commercial-scale wave energy devices are predicted to alter the physical environment, specifically wave energy and sediment transport, which could in turn affect biological communities. Detecting changes from energy devices requires ongoing monitoring before devices are in place and so at least one additional task will be dedicated to improving our analyses of renewable energy projects.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Southern California

**Administered By:** Pacific OCS Region

**Title:** Understanding Biological Connectivity among Offshore Structures and Natural Reefs

**BOEM Information Need(s) to be Addressed:** BOEM needs to continue to advance its knowledge of the biological connectivity of natural reefs and manmade structures in southern California, as well as understand the possible contribution of each platform to mainland and island marine communities. This information is needed to elucidate the role that offshore artificial structures may have in supplying propagules that can influence the composition and function of biological communities. This will enable BOEM to comply with the duties of federal agencies that are outlined in Section 2 of Executive Order 13112 (Invasive Species). BOEM will use study results for environmental reviews concerning existing operations and decommissioning alternatives of offshore platforms and potential marine renewable energy facilities.

**Approx. Cost:** (in thousands) \$800

**Period of Performance:** FY 2017–2020

### **Description:**

Background: Oceanographic modeling suggests various degrees of potential connectivity among Pacific OCS platforms, harbors, and natural habitat for invertebrate taxa with a representative range of planktonic larval duration (PLDs) that provides a basis for hypothesis testing using genetic analyses. Particular taxa of interest include the non-indigenous species (NIS) *Watersipora subtorquata*, with a very short PLD of 24 hours, and two native bivalves, a scallop and a mussel, both with PLDs of days to weeks. Dispersal of these invertebrate species to new sites occurs during the planktonic larval stage when they can be transported from a parent population to other artificial and natural habitats by ocean currents. The degree of exchange of these propagules between source and destination sites is a measure of habitat connectivity. Manmade structures, such as offshore oil platforms and shipwrecks, provide novel attachment substrate for encrusting invertebrates, and it has been proposed that these structures increase habitat connectivity by serving as “stepping stones” that may increase the potential success of dispersal. As such, artificial substrate may facilitate the establishment and spread of NIS and other species by providing novel habitats where none existed previously, and may provide a source of larvae of native species such as the rock scallop and sea mussel to populations in natural habitats.

Objectives: The overall objective of this study is to understand biological connectivity among artificial and natural habitats using genetic markers. The following questions will be examined by this study:

- Is invertebrate species dispersal greater in the offshore than in the nearshore environment?

- Are there distinct genetic structures on groups of offshore platforms, harbors, shipwrecks, and natural reefs for native and non-native species?
- Is gene flow between populations more restricted for species with spatially limited planktonic dispersal?
- Do the genetic structures lead to confirming specific pathways for non-native species introductions?
- What are the effects of location and spacing of artificial structures on natural biological communities?

**Methods:** To meet the overall study objectives, three tasks will be performed.

*(1) Use molecular markers to test the prediction that populations of species with short PLDs will be more similar genetically in habitats in close proximity than those farther apart, whereas, the genetic structure of native species will be more homogenous across sites.* SCUBA divers will sample NIS and native species on (a) oil and gas platforms, (b) harbors, (c) shipwrecks, and (d) nearby natural reefs in sufficient detail for the genetic analysis. Next-generation sequencing (NGS) technology will be used to profile genetic variation of the target species and genotypes will be determined by counting multi-sample alleles.

*(2) Estimate biological connectivity among manmade structures and natural reefs using the data from task (1) and standard genetic connectivity estimates, and use these results to identify possible sources of larvae to platforms and natural reefs.* These results will build on previous studies' predictions of potential connectivity developed from oceanographic and larval tracking modeling. This task will model larval dispersal pathways to and from oil and gas platforms, harbors, shipwrecks, and reefs and identify vulnerable steps in the life history of NIS that can be used to manage future colonization risk (see Task 3). In addition it will assess the role that platforms may have as a source of scallop and mussel larvae to natural habitats.

*(3) Develop an early detection and rapid response monitoring plan.* Once the biological data have been collected and synthesized with other available information, the study will assess the effects of location and spacing of artificial structures on natural biological communities that will inform biological effects from spacing of potential renewable energy installations and develop an early detection and rapid response plan. This plan may include managing point sources and vectors, and other potential actions. Finally, the study will examine potential rigs-to-reefs proposals and how they may affect the risk of NIS establishment to natural habitats.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Hawai‘i

**Administered By:** Pacific OCS Region

**Title:** Public Awareness and Perception of Offshore Wind Development in Hawai‘i

**BOEM Information Need(s) to be Addressed:** As of March 2016, BOEM has received three lease requests for commercial floating wind projects offshore O‘ahu. BOEM Pacific Region plans to move forward with publishing a Call for Information and Nominations and subsequent Area Identification and environmental analyses. The novelty of offshore wind development and potential for stakeholders to misunderstand the leasing process and potential development effects requires that BOEM engage the public early in the process and provide regular opportunities to understand and contribute to development. This BOEM study will provide much-needed information for leasing and subsequent project decisions. This public engagement will also fulfill the Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) provision to ensure greater public participation, follows associated guidance from the Council on Environmental Quality (Council of Environmental Quality 1997) to assure meaningful community representation as early as possible, and is responsive to requests made at BOEM/Hawai‘i OCS Renewable Energy Task Force meetings for more public engagement.

**Approx. Cost:** (in thousands) \$400

**Period of Performance:** FY 2017–2019

### **Description:**

**Background:** Hawai‘i Act 97 (2015) directs the state’s utilities to generate 100% of their electricity sales from renewable energy resources by 2045—the most aggressive renewable energy goal in the nation. A diverse mix of renewable energy sources will be needed to meet this goal, and stakeholders’ awareness and perceptions of sources’ impacts and benefits play a role in determining that energy mix. Offshore wind has been proposed as one viable renewable energy source that can contribute significantly toward meeting Hawai‘i’s energy goal.

Public engagement and outreach are critical for ensuring that Hawaiian communities have accurate information on renewable energy development and their perceptions and input are based on fact and understanding. In the case of offshore wind development, a successful BOEM leasing process (which may or may not result in a lease and/or plan approval) depends on the public’s acceptance of the rational, process, and results.

One example of a science-based offshore wind outreach campaign is that of the University of Delaware College of Earth, Ocean, and Environment. Largely as a result of this outreach effort, 91% of Delaware’s citizens favored offshore wind in a referendum, even if it meant an increase in monthly utility rates (Svenvold 2008). The Delaware

public, armed with a firm understanding of the issues at hand, chose offshore wind despite an aggressive marketing campaign by coal and natural gas electricity providers.

This study will provide BOEM with needed information on:

- Public perceptions of the potential effects of offshore wind development on human, marine, and coastal environments that BOEM will use for siting and environmental analyses, and for informing potential alternatives, lease stipulations, and mitigation measures.
- Public opinions and perceptions about offshore wind development and the BOEM leasing process that will inform future outreach efforts.
- Community values that are most highly correlated with specific locations proposed for development and willingness to support development.

BOEM will consider input from State and local contacts regarding additional information needs to inform Hawai‘i’s renewable energy portfolio. This study aligns with Goal 3 of the BOEM Pacific Region science strategy for renewable energy—track local community perceptions as renewable energy development occurs.

Objectives: The specific objectives of this study are as follows:

1. Collect information on public opinions and perceptions about offshore wind development, including perceived potential effects on human, marine, and coastal environments.
2. Collect spatially explicit data on community values that are most highly correlated with the locations proposed for development and willingness to support development.
3. Develop public education and engagement components to supplement the Pacific Region’s existing outreach efforts that will fill the knowledge gaps identified throughout the study and address public concerns. Working in close coordination with the Pacific Region, disseminate study results and supplementary outreach materials to study participants and Hawaiian communities.

Methods: Appropriate specific methods for the study objectives will be determined through scoping efforts and consultation with State and local contacts. Suggested methods to achieve the referenced objectives are as follows:

Objectives 1–2. Collect data using one or more of the following methods: hold workshops and/or other gatherings for stakeholders with facilitation services by a Native Hawaiian facilitator; conduct in-person interviews; conduct surveys in-person, by phone, or online. The use of community-based research methods and citizen science tools is encouraged to enable potentially impacted communities to be involved in the research and to increase the relevance and usability of the data.

Objective 3. Supplement the Pacific Region’s Hawai‘i offshore wind outreach materials. Use electronic and/or in-person dissemination methods, as appropriate.

**References:**

Council of Environmental Quality. 1997. Environmental Justice Guidance Under the National Environmental Policy Act. Executive Office of the President, Council on Environmental Quality, Washington, DC.

Svenvold, Mark. 2008. "Wind-Power Politics." *The New York Times Magazine*, September 12, 2008.

**Revised Date:** April 20, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Hawai‘i

**Administered By:** Pacific OCS Region

**Title:** Exploration and Research for Hawai‘i Coastal and Ocean Renewable Energy (HI CORE) I: Data Synthesis, Mapping, and Analyses

**BOEM Information Need(s) to be Addressed:** BOEM Pacific Region is currently processing three unsolicited lease requests for floating wind energy projects offshore O‘ahu, Hawai‘i and has initiated its wind energy competitive leasing process. The general ecology of the shoreline and coral fringing reefs around O‘ahu has been characterized. However, farther offshore in the oceanic area of interest, 15–25 miles, 1000–2000 m water depth, on the continental is a relatively unmapped and unstudied region. Specifically, mapping and sampling of volcanic slope communities as well as exploration for other areas of potential historic significance is needed for informed decisions regarding potential wind turbine siting, distribution of habitats and historic sites, and the sensitivity of associated biological communities to impacts. The results of this study will help to define mitigations and identify deep slope coral concentrations, archaeological sites, and any associated sensitive communities that energy development should avoid. Results will be used in potential NEPA documents and to fulfill consultation and analysis requirements under the Migratory Bird Treaty Act, Magnuson-Stevens Fisheries Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act for a wind energy commercial lease off O‘ahu.

**Approx. Cost:** (in thousands) \$1,500      **Period of Performance:** FY 2018–2020

### **Description:**

Background: The Hawai‘i Clean Energy Initiative and renewable energy goals are the most aggressive in the nation, with the Governor setting the goal at 100% clean energy by 2045.

Studies funded by BOEM will soon complete baseline investigations of Hawaiian coastal cultural and historic sites, bring together a biogeographic assessment of the offshore area for the main islands, determine the human uses of the coastal zone, and study the at-sea ranging behavior of seabirds. These baseline studies were critical to understand the Hawaiian frontier area for the Pacific Region. Discussion with other major federal and state agencies may now allow an offshore area south of O‘ahu to be available for renewable energy leasing.

BOEM has received a total of three unsolicited wind energy lease requests from two potential developers: two lease requests from AW Hawai‘i Wind, LLC (AWH), the AWH O‘ahu Northwest Project and the AWH O‘ahu South Project; and one from Progression Hawai‘i Offshore Wind, Inc. (Progression), the Progression South Coast of O‘ahu Project. Each project proposes an offshore floating wind energy facility with a capacity of approximately 400 megawatts (MW) of renewable energy. The energy generated by

the projects would be transmitted to O‘ahu by undersea cables. BOEM Pacific Region is now initiating its wind energy competitive leasing process.

There are no geophysical or surface anomaly maps or detailed characterizations of habitats for the area of interest. The NOAA Office of Ocean Exploration and Research has surveyed other Hawaiian areas, using remotely operated vehicles, in the general bathymetric range of 1000–2000 m and deeper, and has documented sensitive deepwater coral concentrations and volcanic lava flows. Although within Hawai‘i boundaries, the areas explored by NOAA were far from human settlements. In addition, the cultural importance of O‘ahu and the historic significance to the U.S. and Japan of the area south of Pearl Harbor also necessitate a close examination of the area. The *HI CORE I: Data Synthesis, Mapping, and Analyses* study is the first step in the process to define mitigations and identify sensitive biological areas, archaeological sites, potential shallow hazards, and any associated communities that energy development should avoid.

**Objectives:** The goal of HI CORE is to explore and characterize the deep slope area south of O‘ahu in anticipation of commercial wind energy installations. Specific objectives are as follows:

- To gather data and define the footprint area for exploration and plan mapping and surveying
- To map and geo-reference the footprint using high-resolution multibeam surveying and sub-bottom profiling
- To analyze mapped data in order to characterize possible geo-habitats, potential shallow hazards, and cultural and historic sites, and choose and refine target locations for further study and/or delineate as potential avoidance areas

**Methods:** This project will require the use of sophisticated submerged instrumentation capable of high-resolution bottom imagery at depths of 500–1000 m. This could include ship-based devices or autonomous underwater vehicles (AUVs) or towed fish for mapping. Large-scale mapping will be required to define substrate type and distribution of potential hard bottoms associated with canyons as well as more distinct slope areas. Attempts will be made to partner with USGS and potentially NOAA for surveys, sediment study, physical oceanography, submerged instrumentation, and research vessel facilities for all or part of the efforts.

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Southern California, Central California, Northern California, Washington-Oregon, Hawai‘i

**Administered By:** Pacific OCS Region

**Title:** Pacific Seabird Monitoring Program

**BOEM Information Need(s) to be Addressed:** Seabirds face numerous threats to survival; nearly a third of seabird species are at some risk of extinction. Offshore wind turbines are a potential new source of avian mortality, although proper mitigation through infrastructure positioning and lighting schemes can greatly reduce this potential. The effectiveness of these mitigation strategies needs to be confirmed via a cost-effective monitoring program that will (1) estimate the rate of bird strike from wind turbine operations, and (2) elucidate regional population trends of vulnerable species. In combination, these two approaches can indicate when corrective management actions would be necessary, if any. The purpose of this study is to develop a monitoring program using acoustic methods for prospective offshore energy projects within the entire Pacific OCS Region. This study will satisfy requirements for Endangered Species Act consultations, National Environmental Policy Act impact analyses, and Migratory Bird Treaty Act requirements. Additionally, this study conforms to the principles outlined in the 2014 strategy for improving the mitigation policies and practices of the Department of the Interior.

**Approx. Cost:** (in thousands) \$1,750      **Period of Performance:** FY 2018–2022

### **Description:**

**Background:** Seabirds play an important role in marine ecosystems and have been identified as a wildlife resource that could potentially be impacted by the operation of offshore wind turbines (Boehlert, *et al.* 2013). In developing the information base needed for management decisions, BOEM has first focused on synthesizing available knowledge and conducting large baseline surveys that describe the distribution and abundance of seabird populations. Using these results, mitigation measures will be developed to eliminate or reduce potential impacts to seabirds from proposed offshore projects (*e.g.*, siting of facilities to avoid areas where seabirds congregate in large numbers). The next step in constructing a comprehensive environmental program is to monitor environmental outcomes of employed mitigation measures using cost-effective methods. Furthermore, to discriminate changes resulting from project activities from changes that occur independently of offshore development, monitoring must begin before impacts occur. This study seeks to develop this next programmatic step by building upon ongoing BOEM studies, including *Developing and Applying a Vulnerability Index for Scaling the Possible Adverse Effects of Offshore Renewable Energy Projects on Seabirds on the Pacific OCS* (BOEM 2015a) and *Synopsis of Research Programs that can Provide Baseline and Monitoring Information for Offshore Energy Activities in the Pacific Region* (BOEM 2015b).

**Objectives:** The objectives of this study are to (1) trial acoustic methods to estimate the rate of bird strike from wind turbine operations, and (2) coordinate and support a monitoring program of vulnerable seabird species that encompasses prospective offshore wind energy projects in the Pacific OCS. These objectives will be met by conducting the following tasks:

1. Using terrestrial analogs, assess the utility of acoustic technology used to successfully estimate rates of bird strike on electric power lines to estimate rates of bird strike on wind turbines.
2. Using the *Vulnerability Index* and other sources of information, identify a suite of indicator seabird species in the Pacific Region suitable for a monitoring program.
3. Building upon information gathered by the *Synopsis of Research Programs*, review ongoing monitoring efforts (including those that feature Citizen Science), to determine which programs would be worthy to coordinate over larger scales and perhaps supplement with acoustic sensor devices or other support in order to meet objectives for a draft monitoring program.
4. Via a series of small workshops, draft a monitoring program that aims to distinguish population trends resulting from offshore energy projects compared to other factors, such as sea level rise, degraded ocean productivity, or fisheries bycatch.
5. Conduct a 3-year regional monitoring effort that will refine baseline information and will improve site-specific estimates of species diversity and the acoustic signal-density relationship.
6. Write final report, which will include an acoustic database.

**Methods:** Most tasks will use standard approaches to accomplish objectives. The comparatively new methodology in this study proposes to apply acoustic technology to seabird monitoring. Acoustic sensors have recently been developed to estimate avian mortalities from electric power lines, and work is underway to transfer this technology to estimate impacts from wind turbine operations. Alternative means to measure rates of bird strike are needed because many traditional methods to estimate avian mortality (e.g., carcass removal) do not work in an offshore environment, or cannot be implemented in an economical manner at regional scales (e.g., radar). Acoustic sensors are also an effective tool for monitoring the presence, distribution, and relative abundance of rare and elusive seabirds (Borker, *et al.* 2014). The application of acoustic sensors will enable consistency and exceptional cost efficiency for long-term monitoring.

This study satisfies principles outlined by the Clement *et al.*, (2014) report to the Secretary of the Interior (Clement, *et al.* 2014) which states that monitoring of mitigation measures should (1) adopt a regional or landscape-scale approach; (2) begin planning at the outset of project development; (3) develop and utilize tools necessary for efficient monitoring; (4) coordinate with other entities in assessing the existing and projected resource conditions; and (5) evaluate conditions over time to insure intended outcomes are achieved.

## References:

- Boehlert, G., C. Braby, A.S. Bull, M.E. Helix, S. Henkel, P. Klarin, and D. Schroeder, eds. 2013. Oregon Marine Renewable Energy Environmental Science Conference Proceedings. U.S. Department of the Interior, Bureau of Ocean Energy Management, Cooperative Agreement with Oregon State University M12AC00012. OCS Report BOEM 2013-0113. 134 p.
- BOEM. 2015a. Developing and Applying a Vulnerability Index for Scaling the Possible Adverse Effects of Offshore Renewable Energy Projects on Seabirds on the Pacific OCS (PC-12-01). Last revised December 10, 2015. Bureau of Ocean Energy Management: <http://www.boem.gov/pc-12-01/>.
- BOEM. 2015b. Synopsis of Research Programs that can Provide Baseline and Monitoring Information for Offshore Energy Activities in the Pacific Region (PR 14-DMI). Last revised December 10, 2015. Bureau of Ocean Energy Management: <http://www.boem.gov/PR-14-DMI/>.
- Borker, A.L., M.W. McKown, J.T. Ackerman, C.A. Eagles-Smith, B.R. Tershy, and D.A. Croll. 2014. Vocal activity as a low cost and scalable index of seabird colony size. *Conservation Biology* 28:1100-1108.
- Clement, J., A. Belin, M. Bean, T. Boling, and J. Lyons. 2014. A strategy for improving the mitigation policies and practices of the Department of the Interior. A report to the Secretary of the Interior from the Energy and Climate Change Task Force, Washington, D.C., 25 p.  
[https://www.doi.gov/sites/doi.gov/files/migrated/news/upload/Mitigation-Report-to-the-Secretary\\_FINAL\\_04\\_08\\_14.pdf](https://www.doi.gov/sites/doi.gov/files/migrated/news/upload/Mitigation-Report-to-the-Secretary_FINAL_04_08_14.pdf).

**Revised Date:** March 28, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**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 important information about 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<sup>5</sup>      **Period of Performance:** FY 2017–2019

### **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 to assess cumulative effects of variables (*e.g.*, OCS development) can be run with a single stressor or 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.

---

<sup>5</sup> \$2,400 from BOEM, \$1,200 from NOAA; although model could be downsized to reduce costs (please see Methods).

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 is focused on fisheries; however, it can be used to understand the impact of pollution, coastal development and broad-scale environmental change on ecosystems. 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 and cumulative effects of OCS development and climate change on key fisheries, protected species, essential fish habitat and ecosystem function.

**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 25%; 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.

**Objective #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.

**Objective #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.

**Objective #3 –** (A) 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 11, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

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

**Administered By:** Gulf of Mexico 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 builds upon and leverages partnerships from the successful multi-agency Mid-Atlantic Canyons study that provided important and surprising new baseline information about deepwater habitats and species. BOEM requires additional such information from other priority geographic areas in the Mid- and South Atlantic to support the agency's mission across program areas. Study results would directly benefit BOEM's pre- and post-lease responsibilities by improving the scientific and legal adequacy of NEPA Environmental Impact Statements (EIS's), supporting interagency consultations, and informing early planning for potential mitigation strategies.

**Approx. Cost:** (in thousands) \$4,000<sup>6</sup>    **Period of Performance:** FY 2017–2021

### **Description:**

**Background:** Authoritative baseline information for the Mid- and South Atlantic is required by BOEM to inform decision making across program areas. Important differences between the Gulf and the Atlantic related to types of benthic habitats (e.g., depth preferences) and species presence require improved description in EIS's and may also require BOEM to make adjustments to future mitigation assumptions and strategies. Previous cruises have documented numerous new deepwater coral communities and (unexpectedly) new chemosynthetic communities in the region, but have left many potential sites unexplored. BOEM requires additional such information focused on the identification, biodiversity, ecology, and food-web dynamics of deepwater benthic communities associated with Atlantic hard bottoms and seeps.

Building upon the award-winning paradigm for deepwater research established by the FY 2010-2016 study "Exploration and Research of Mid-Atlantic Deepwater Hard Bottom Habitats and Shipwrecks with Emphasis on Canyons and Coral Communities," this study will continue BOEM's partnership with the NOAA Office of Exploration and Research (OER) and the United States Geological Survey (USGS), under the auspices of the National Ocean Partnership Program (NOPP), with a new partner agency in the NOAA Deep Sea Coral Research and Technology Program (DSCRTP) which will act as data portal and advise on overall national deep coral research and management. All partners benefited from the previous study results, which expanded the limited baseline information about Atlantic habitats and species in Baltimore and Norfolk Canyons, including unexpected discoveries of the structure-forming deepwater coral *Lophelia pertusa* and a dense methane seep community. Results also revealed that even

---

<sup>6</sup> + ~\$11,000 in co-sponsor matching funds.

neighboring canyons can have very different species presence and environmental controls (<http://www.boem.gov/press05272015/>). This study aims to investigate new Mid- and South Atlantic priority areas possessing canyons, hard bottoms, and seep habitats likely to support undiscovered deepwater benthic communities. Potential geographic regions of interest include several unexplored canyon systems offshore of North Carolina as well as unmapped portions of the Blake Plateau; final target areas will be further developed with interagency partners and the future contractor.

**Objectives:** This study will enhance insufficient baseline habitat information in specific offshore areas of the Atlantic Large Marine Ecosystem. Mapping efforts focused on coverage gaps will enhance understanding of the fundamental geologic/geomorphic characteristics influencing species distributions and ecological functions and will improve predictive models used by managers. Biological characterization of the location, abundance, connectivity, and ecological importance of deepwater benthic communities, including structure-forming coral and seep-associated organisms, will lead to an improved understanding of disturbance sensitivity. Elucidating essential differences between Atlantic and Gulf habitats will be of particular importance when developing future mitigations. Measurement and analysis of relevant environmental conditions at the seafloor and in the water column (e.g., turbidity, nutrient inputs) may reveal important biological controls and benthic-pelagic connections. Overall, this study would improve understanding of the functional role of benthic habitats within the wider Atlantic ecosystem and inform near-term and future management decisions regarding its balanced stewardship.

**Methods:** Borrowing from the previous study's proven scientific and administrative methods will help ensure successful implementation of this study. NOPP sponsorship and expressed senior management support from all partner agencies will help ensure exceptional communication and collaboration between all parties, from initial planning to final report. Each agency will provide its unique expertise and capabilities: BOEM's focus on fulfilling management needs; USGS's multidisciplinary scientific expertise; and NOAA OER's education and outreach, data management, and ship/submersible coordination abilities. The RFP will detail specific contractor requirements. A broad range of interdisciplinary methods will be employed to sample and characterize selected coral and chemosynthetic communities and benthic-pelagic environmental conditions. Appropriate high resolution, ship-based mapping technologies will delineate substrate types and document the distribution of hard bottom areas. Sophisticated submergence facilities (e.g., ROVs, AUVs, gliders) will provide additional seafloor imagery and enable collection of seafloor samples and environmental parameters. Collected data will be analyzed using appropriate laboratory materials/protocols and software systems in order to describe community composition, complexity and sensitivity to impacts. Data management best practices and annotation consistent with the Coastal and Marine Ecological Standard will be followed to ensure information accessibility, with coral and sponge locations submitted in a format consistent with the DSCRTP's national geodatabase. Study results will be made available via peer-reviewed literature, a final report, and as datasets in usable formats such as GIS layers. These will be of interest to BOEM analysts, other resource managers, researchers, and the general public.

**Revised Date:** April 11, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Mid- and South Atlantic

**Administered By:** Gulf of Mexico OCS Region

**Title:** History of Seismic Surveys on the U.S. OCS in Comparison to Long-Term Indicators of Ecosystem Health

**BOEM Information Need(s) to be Addressed:** The BOEM has been working together with other federal and state agencies to obtain approval of Atlantic G&G permits for seismic surveying in the Mid- and South Atlantic Planning Areas. The BOEM continues to actively disseminate the best available science to stakeholders regarding potential impacts of seismic surveys on living marine resources. This study will provide an analysis of the history of seismic surveys on the U.S. OCS, including in the Gulf of Mexico, in comparison to long-term indicators of ecosystem health to further inform G&G permitting on the Atlantic OCS.

**Approx. Cost:** (in thousands) \$400

**Period of Performance:** FY 2018–2020

### **Description:**

**Background:** The Atlantic G&G permitting process could be informed by a more thorough analysis of the history of seismic surveys in comparison to a synthesis of long-term ecosystem health indicators on the U.S. OCS. For the past 30 years, BOEM (BOEMRE/MMS) has issued permits for conventional 2-D and 3-D seismic surveys as well as for multi-component, high resolution, wide-azimuth and other advanced types of seismic surveys with the majority of them being collected on the Gulf of Mexico OCS. A variety of agencies have been collecting information on the status and health of Gulf of Mexico offshore living marine resources and habitat during this same period, data which could be synthesized and compared to the timing and location of historical seismic surveys to analyze for any related marine ecosystem changes.

**Objectives:** The objective of this study is to determine whether historical seismic survey activity on the U.S. OCS is quantifiably related to changes in indicators of marine health and productivity.

**Methods:** Time series of ecological datasets will be compiled in U.S. OCS regions with a history of G&G seismic survey activity. The study will mostly focus on the long history of activity in the Gulf of Mexico, a region with significant connectivity to the Mid- and South Atlantic Planning Areas of interest. The history of seismic survey data in the Gulf will be compiled to provide time-series related to level-of-activity and spatial distribution. Long-term ecological datasets will be compiled for comparison, including Flower Garden Banks Long-Term Monitoring datasets, fisheries and plankton surveys, marine mammal surveys, strandings data, unusual mortality events, and any other data of relevance. Statistical analyses will be used to assess the drivers of change observed in ecological time series, and whether those changes are likely related to anthropogenic activities, such as seismic surveying, or natural mechanisms, such as changes in river discharge and weather.

**Revised Date:** April 11, 2016

## **Environmental Studies Program: Studies Development Plan FY 2017–2019**

**Study Area(s):** Mid- and South Atlantic

**Administered By:** Gulf of Mexico OCS Region

**Title:** Ecosystem Services Approach to Assessing the Impacts of Offshore Development in the Mid- and South Atlantic

**BOEM Information Need(s) to be Addressed:** The BOEM is actively working with federal agencies, state agencies, and the public to disseminate the best available science regarding potential impacts of OCS development across program areas on both humans and the environment. This study will provide an ecosystem services analysis for Atlantic offshore waters which values the various services this ecosystem provides and further informs the pros and cons of offshore development in these waters.

**Approx. Cost:** (in thousands) \$500      **Period of Performance:** FY 2018–2020

### **Description:**

**Background:** The Mid- and South Atlantic marine ecosystem provides numerous services to both humans and the environment. There have been significant advances in the application of environmental valuation techniques to marine waters over the last decade. These studies have provided a means of quantifying the variety of services that different marine ecosystems around the world can provide. Ecosystem services are traditionally divided into three categories, related to Provisioning services (*e.g.*, food, ornamentals, biotechnology, and energy), Regulating services (*e.g.*, clean water, biodiversity, coastal protection, and climate stability), and Cultural services (*e.g.*, sense of place, tourism and recreation, science and education, heritage). A major gap exists in the application of ecosystem service valuation to deep sea marine ecosystems. Such application of ecosystem services to deep sea marine ecosystems was demonstrated to be useful in the Gulf of Mexico in a recent National Research Council analysis of the impacts of the Deepwater Horizon on deepwater ecosystems, and could similarly provide a useful synthesis of ecosystem services in the Atlantic.

**Objectives:** The objective of this study is to provide an ecosystem services analysis for the Mid- and South Atlantic which considers the numerous services provided and better informs tradeoffs related to offshore development.

**Methods:** An appropriate valuation technique will be utilized to determine the relative economic value of the various ecosystem services the Mid- and South Atlantic provides. In addition to an assessment of the various regulating and cultural services, provisioning services will include offshore activities regulated by BOEM including offshore energy development and marine minerals. The end product will provide a more comprehensive basis for analyzing the various cultural, ecological, and economic factors that need to be considered in determining the tradeoffs of proposed offshore activities.

**Revised Date:** March 28, 2016

## APPENDIX III. ABBREVIATIONS AND ACRONYMS

2-D	two-dimensional
3-D	three-dimensional
ADCP	acoustic Doppler current profiler
ADEON	Atlantic Deepwater Ecosystem Observatory Network
AEA	Alaska Energy Authority
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee Model
AEWC	Alaska Eskimo Whaling Commission
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMBON	Arctic Marine Biodiversity Observing Network
ANCSA	Alaska Native Claims Settlement Act
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
ANSI	American National Standards Institute
AOOS	Alaska Ocean Observing System
API	American Petroleum Institute
APRS	Automatic Packet Reporting System
ARCTREX	Arctic Tracer Release Experiment
ARGOS	Advanced Research and Global Observation Satellite
ASAMM	Aerial Surveys of Marine Mammals
ATOM	Acoustic and Thermographic Offshore Monitoring
AUV	autonomous underwater vehicle
AWH	AW Hawaii Wind
BACI	Before-After-Control-Impact
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement
BON	Biodiversity Observing Network
BP	BP public limited company (formerly: “British Petroleum”)
BSEE	Bureau of Safety and Environmental Enforcement
C2O2	Coastal Community Ocean Observers
ca.	<i>circa</i> (English: “approximately”)
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
Cal CORE	California Coastal and Ocean Renewable Energy
CALPUFF	California Puff

cANIMIDA	Continuation of the Arctic Nearshore Impact Monitoring in the Development Area
CEQ	Council on Environmental Quality
CES	Center for Energy Studies
CFR	Code of Federal Regulations
CMAQ	Community Multiscale Air Quality
CMI	Coastal Marine Institute
COSA	Committee on Offshore Science and Assessment
CPA	Central Gulf of Mexico Planning Area
CPUE	catch per unit effort
CSLI	CubeSat Launch Initiative
CT	computerized tomography
CTD	conductivity, temperature, and depth
CWA	Clean Water Act
CY	calendar year
CZM	coastal zone management
dB	decibel
DBO	distributed biological observatory
DES	Division of Environmental Sciences
DNA	deoxyribonucleic acid
DOE	Department of Energy
DOI	Department of the Interior
DPP	development and production plan
DRAMAD	Dynamic Risk Assessment Model for Acoustic Disturbance
DSCRTP	Deep Sea Coral Research and Technology Program
DWH	<i>Deepwater Horizon</i>
E&D	exploration and development
E&P	exploration & production
e.g.	<i>exempli gratia</i> (English: “for example”)
E.O.	Executive Order
EA	Environmental Assessment
EBM	ecosystem-based management
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic field
ENSO	El Niño Southern Oscillation
EP	exploration plan
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ESA	Endangered Species Act

ESID	EcoSpatial Information Database
ESP	Environmental Studies Program
ESPIS	Environmental Studies Program Information System
ESP-PAT	Environmental Studies Program Performance Assessment Tool
et al.	<i>et alia</i> (English: “and others”)
et seq.	<i>et sequens</i> (English: “and the following”)
etc.	<i>et cetera</i> (English: “and so forth”)
EVOSTC	<i>Exxon Valdez</i> Oil Spill Trustee Council
EwE	Ecopath with Ecosim
<i>ex situ</i>	(English: “off site”)
FERC	Federal Energy Regulatory Commission
FON	fiber optic network
FY	fiscal year
G&G	geological and geophysical
GCCESU	Gulf Coast Cooperative Ecosystem Studies Unit
GCCF	Gulf Coast Claims Facility
GC-MS	gas chromatography - mass spectrometry
GCOOS	Gulf of Mexico Coastal Ocean Observing System
GEI	Gulfwide Emission Inventory
GHG	greenhouse gas
GIS	geographic information system
GMAQS	Gulf of Mexico Air Quality Study
GODEON	Gulf of Mexico Deepwater Ecosystem Observatory Network
GOM	Gulf of Mexico
GOMA	Gulf of Mexico Alliance
GOMESA	Gulf of Mexico Energy Security Act
GoMMAPPS	Gulf of Mexico Marine Assessment Program for Protected Species
GOMR	Gulf of Mexico Region
GoMRI	Gulf of Mexico Research Initiative
GOM-SCHEMA	Gulf of Mexico Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology, and Archaeology
GPS	Global Positioning System
GSM	Global System for Mobile communications
GUIS	Gulf Islands National Seashore
HF	high-frequency
HI CORE	Hawai‘i Coastal and Ocean Renewable Energy
HPPG	high priority performance goal
i.e.	<i>id est</i> (English: “that is”)
IA	interagency agreement

ICIS	Integrated Compliance Information System
IMPLAN	Impact Analysis for Planning
<i>in situ</i>	(English: “on site”)
Inc.	incorporated
IOOS	Integrated Ocean Observing System
ITM	information transfer meeting
IWC	International Whaling Commission
kWh	kilowatt hour
LA	Louisiana
LEO	Local Environmental Observer
LiDAR	Light Detection and Ranging
LLC	limited liability company
LME	large marine ecosystem
LNG	liquefied natural gas
LSU	Louisiana State University
MAGPLAN	Model of Alaska and Gulf using Impact Analysis for Planning
MARCO	Mid-Atlantic Regional Council on the Ocean
MARFIN	Marine Fisheries Initiative
MARINE	Multi-Agency Rocky Intertidal Network
MBTA	Migratory Bird Treaty Act
MET	meteorological
MHI	Main Hawaiian Islands
MHK	marine hydrokinetic
MIA	missing in action
MIMES	Multi-Scale Integrated Model of Ecosystem Services
MINT	Minerals Management Service Intertidal Team
MML	Marine Mammal Laboratory
MMP	Marine Minerals Program
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSE	Management Strategy Evaluations
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MT	megatonne
mtDNA	mitochondrial deoxyribonucleic acid
MW	megawatts
n.d.	no date
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration

NAZ	No Activity Zone
NEPA	National Environmental Policy Act
NEPTUNE	North East Pacific Time-series Underwater Networked Experiments
NEXRAD	Next-Generation Radar
NGO	non-governmental organization
NGS	next-generation sequencing
NHPA	National Historic Preservation Act
NIC	National Ice Center
NIS	non-indigenous species
nm	nautical mile
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuaries
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Oceanographic Partnership Program
NORM	naturally-occurring radioactive material
NOSB	National Ocean Sciences Bowl
NPDES	National Pollutant Discharge Elimination System
NPRB	North Pacific Research Board
NPS	National Park Service
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NROC	Northeast Regional Ocean Council
NSB	North Slope Borough
NSF	National Science Foundation
NSL	National Studies List
NWS	National Weather Service
OBIS-SEAMAP	Ocean Biogeographic Information System – Spatial Ecological Analysis of Megavertebrate Populations
OCD	Offshore and Coastal Dispersion Model
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OEP	Office of Environmental Programs
OER	Office of Ocean Exploration and Research
OMI	Ozone Monitoring Instrument
OOC	Offshore Operators Committee
OREP	Office of Renewable Energy Programs
OSRA	oil spill risk analysis
OSTP	Office of Science and Technology Policy
OSV	offshore support vessel

P.L.	Public Law
PACMAPPS	Pacific Marine Assessment Partnership for Protected Species
PAM	passive acoustic monitoring
PCB	polychlorinated biphenyl
plc	public limited company
PLD	planktonic larval duration
polSAR	polarimetric synthetic aperture radar
POW	prisoner of war
PRISM	Pacific Regional Investigation Survey and Monitoring
PSIX	Port State Information Exchange
PSO	protected species observer
QA	quality assurance
QC	quality control
R/V	research vessel
RAPID	Grants for Rapid Response Research
RASS	Radio Acoustic Sounding System
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunity, and Revived Economics of the Gulf States Act of 2011
RFP	request for proposal
RODEO	Real-time Opportunity for Development Environmental Observation
ROV	remotely operated vehicle
ROW	rights-of-way
RSM	Regional Sediment Management
SAMP	Special Area Management Plan
SCUBA	self-contained underwater breathing apparatus
SDP	Studies Development Plan
SEABOSS	Seabed Observation and Sampling System
SERPENT	Scientific Environmental Remotely Operated Vehicle Partnership using Existing Industrial Technology
SEUS	Southeastern United States
SIA	social impact assessment
SME	subject matter expert
SMWG	Sand Management Working Group
SNE	Southern New England
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
SQL	structured query language
STEM	science, technology, engineering, and mathematics
SVOC	semi-volatile organic compound
SWAN	Simulating Waves Nearshore
SWSS	Sperm Whale Seismic Study

TCEQ	Texas Commission on Environmental Quality
TCP	traditional cultural property
TDS	total dissolved solids
TK	traditional knowledge
U.S.	United States
U.S.C.	United States Code
UAF	University of Alaska Fairbanks
UAS	unmanned aircraft systems
UAV	unmanned aerial vehicle
UAVSAR	Uninhabited Aerial Vehicle Synthetic Aperture Radar
UF	University of Florida
USACE	United States Army Corps of Engineers
USDOC	United States Department of Commerce
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VENUS	Victoria Experimental Network Under the Sea
VHF	very high frequency
viz.	<i>videlicet</i> (English: “namely”)
VMT	VEMCO Mobile Transceiver
VOC	volatile organic compound
vs.	<i>versus</i> (English: “in contrast to”)
WEA	Wind Energy Area
WEC	wave energy converter
WPA	Western Gulf of Mexico Planning Area
WRF	Weather Research and Forecasting
WRF Chem	Weather Research and Forecasting couple with Chemistry