

BOEM OCEAN SCIENCE

THE SCIENCE & TECHNOLOGY JOURNAL OF THE BUREAU OF OCEAN ENERGY MANAGEMENT

VOLUME 10 ISSUE 2 • APRIL/MAY/JUNE 2013



Celebrating the 40th Anniversary of the
Environmental Studies Program

**Honoring 40 Years of
Applied Ocean Science**

**Partnerships in Science:
Research on the Alaska OCS**

**Atlantic Environmental
Baseline Studies Pivotal to
Marine Planning**

**A History of Biological
Investigations and Discovery
in the Gulf of Mexico**

**From Baseline to Beyond:
40 Years of Pacific
Environmental Studies**

**Sustained Commitment to
OCS Stewardship Through
Long-Term Environmental
Monitoring**

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BOEM OCEAN SCIENCE is published quarterly by the Bureau of Ocean Energy Management to communicate recent ocean science, technological information, and issues of interest related to offshore energy recovery, marine minerals, and ocean stewardship.

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ON THE COVER

Biological Oceanographer Greg Boland photographs a coral head using a camera framer at the East Flower Garden Bank in 1978. Using photos such as these, biologists can measure coral growth rates over time. Photo by Larry Martin, LGL Ecological Research Associates.

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FREQUENTLY USED ABBREVIATIONS

BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
DOI	Department of the Interior
ESP	Environmental Studies Program
MMS	Minerals Management Service
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
USGS	U.S. Geological Survey

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THE DIRECTOR'S MESSAGE

This issue of *BOEM Ocean Science* celebrates four decades of our mission-driven research program.

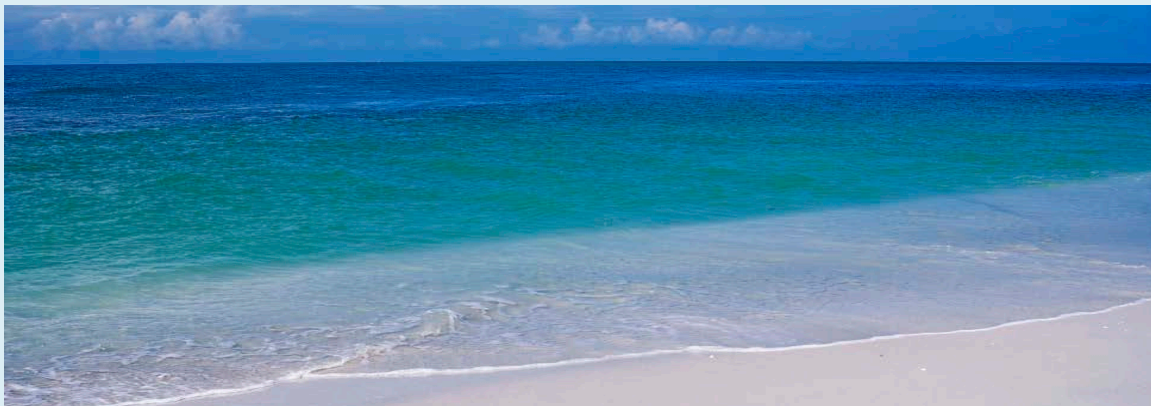
The Environmental Studies Program (ESP) was initiated in 1973 to support the U.S. Department of the Interior's (DOI) Outer Continental Shelf (OCS) oil and gas leasing program. As other energy sources have been added to our Nation's portfolio and technology advanced, the program has evolved to include studies used to support the responsible development of OCS renewable energy. This includes wind energy and the emerging fields of marine hydrokinetic energy (waves, tides, and ocean currents). The ESP also provides information for the use of non-energy mineral resources such as OCS sand for beach restoration and coastal protection. In addition to providing information for National Environmental Policy Act (NEPA) analyses, information collected through the program addresses requirements under the Endangered Species Act, the Marine Mammal Protection Act, the Clean Air Act, the Magnuson-Stevens Fishery Conservation and Management Act, the National Historic Preservation Act, and the Clean Water Act, among other laws.

In its 40th year, BOEM's ESP continues to develop, fund, and conduct world-class scientific research designed to provide critical information to inform policy decisions regarding energy and mineral development on the OCS. Our multi-disciplinary research includes marine archaeology, biology, meteorology and air quality, physical oceanography, fates and effects, protected species studies, and social and economic studies. The broad spectrum of research and monitoring undertaken through the ESP contributes to the bureau mission and long-term DOI goals focusing on environmentally sound development of our Nation's energy and mineral resources. The ESP research portfolio addresses a wide variety of environmental concerns and issues, complementing and building upon broader strategic plans that guide DOI-wide policies and support President Obama's *National Ocean Policy*.

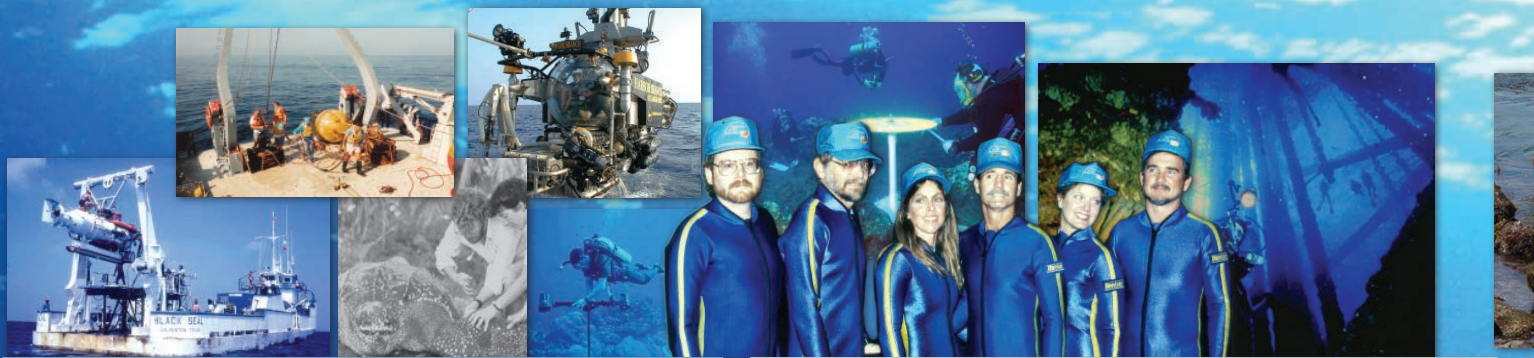
A hallmark of the program is the effective use of partnerships, which combine and leverage resources with academic institutions, state and federal agencies, tribes, and the private sector. Our research program has consistently been recognized for excellence in partnering, and has earned both the DOI Partners in Conservation Award and the National Oceanographic Partnership Program Excellence Award.

Please enjoy reading about our outstanding ocean research program.

Tommy P. Beaudreau, Director



Shoreline, Gulf Coast, Florida. Photo by Patricia Schmidt/istockphoto/Thinkstock.



1973-1983

1983-1993



Message from the Environmental Studies Program Chief Honoring 40 Years of Applied Ocean Science



BOEM's Environmental Studies Program (ESP) was born in the early 1970s, when the U.S. began a new chapter in environmental laws and practices. When the ESP was created, many of these new laws were particularly applicable to the Outer Continental Shelf (OCS), where energy development was already taking place under the Outer Continental

Shelf Lands Act. The ESP helped establish a bridge between OCS development and protecting the environment, and it has evolved into a strategic-planning program that is forward-looking in its consideration of the science needed to assess the effects of OCS activity. Today, it also includes planning for OCS renewable energy development and extraction of marine minerals for coastal restoration. ESP scientists use their expertise to answer the necessary science questions for application to National Environmental Policy Act (NEPA) documents as well as various legal requirements. These include protecting marine mammals, endangered species, essential fish habitat, clean water, clean air, historic and cultural resources, and understanding the impacts of OCS use on society, among other priorities.

However, the utility of our science does not stop with legal requirements. There are many ways in which science can inform ocean energy planning. Scientific information can enhance objectivity, minimize uncertainty, and build

trust among engaged stakeholders. Moreover, scientific information in a planning process reduces misperception and conflict, clearing the way for evidence-based discussions and negotiations. Scientifically collected and analyzed baseline data can provide an assessment of current conditions and allows resource managers to monitor the effects of their management decisions over time. A better understanding of physical, biological, and social science data regarding ocean uses allows resource managers to set measurable goals and outcomes. Scientific information on ocean space usage can form the basis for stakeholder engagement and conflict resolution strategies. Modeling and simulations based on scientific information can create an enhanced understanding of coastal and marine impacts from climate change or human-induced catastrophic events such as oil spills. This information is critical for a forward-looking marine planning process and ecosystem-based management.

Over the past 40 years, the ESP has achieved many accomplishments through strategic planning and is currently looking forward to identify the information needs that are over the horizon. Throughout our proud history, the benefits of the ESP have been clear. Our studies have led to the establishment of avoidance and mitigation measures; increased our knowledge of marine habitat use, sensitivity, and ecosystem productivity; and provided baseline data for monitoring air and water quality, among other uses. Our science-based approach to inform decisions on ocean energy allows for safe



1993-2003

2003-2013

energy production on the OCS. It allows our Nation to benefit from domestic energy production while ensuring our ocean ecosystems are protected.

The ESP currently stands stronger than ever. More than 200 scientists across all of our regions and offices offer expertise on par with top academic and research institutions across the U.S. Every study idea is reviewed by a team of both internal and external subject matter experts who engage and lend varying perspectives to the process. External review of study ideas is provided by BOEM's OCS Scientific Committee, a Federal Advisory Committee Act-compliant group composed of members from academia, government, and industry. These members provide advice on the feasibility, appropriateness, and scientific value of the proposed efforts. This collegial style to applied science allows for up-front vetting and overall improvements to our scientific endeavors.

Over the last few years, the ESP has taken even further strides to improve our program. First, our outreach and education activities have been enhanced by engaging more with our scientific peers and by providing educational materials produced by our scientists for classroom instruction. Second, we are broadening our partnerships not only with new Federal agency partners but also by further exploring partnerships with industry, foundations, private entities, and Native American and Alaska Native tribes. As a result of these outreach efforts, the overall credibility of the ESP has blossomed. We are now recognized as a program of world-class scientists that produces

world-class science. This is something of which our Nation can and should be proud.

Of course, the most critical component of our long history is the people who made it all possible. The ESP has had the privilege of employing some of the best scientists across the Nation. These men and women have worked diligently through fluctuating political and budgetary changes to ensure program success. We have persevered through the years and shined whenever called upon. We understand, as a team, that we share certain values and a commitment to applied science. This shared vision sustains the scientific basis of the ESP and allows for informed decisions to be made with regard to resource management. Throughout our existence, this motivating factor, while tested often, has never wavered. The values we share and the continued strength of character of our people make up the ESP's scientific backbone.

The ESP has a marvelous 40-year story. The pages of this issue of *BOEM Ocean Science* capture the history of the program and the individuals who make it all possible.

Dr. Rodney E. Cluck

FOR MORE INFORMATION:

BOEM's Environmental Studies Program Information System (ESPIS)
http://www.data.boem.gov/homepg/data_center/other/espis/espismaster.asp?appid=1

Partnerships in Science: Research on the Alaska OCS

THE ENVIRONMENTAL STUDIES PROGRAM

In Alaska, the Environmental Studies Program (ESP) has worked since 1973 to develop, conduct, and oversee world-class research to inform policy and to promote science-based decision making. Research under the ESP includes physical oceanography, atmospheric sciences, biology, protected species, social sciences and economics, submerged cultural resources, and environmental fates and effects. Through the ESP, BOEM is a leading contributor to the growing body of information about the human, marine, and coastal environments of our most northern state. The ESP actively pursues collaboration with external science programs by combining and leveraging resources to satisfy common scientific needs with other Federal, State, and university partners. Some significant partners include the National Oceanic and Atmospheric Administration; the Alaska Department of Fish and Game; the University of Alaska Fairbanks; and the U.S. Geological Survey.

The ESP also collaborates closely on specific projects with multiple stakeholders and regional institutions, such as the Interagency Arctic Research Policy Committee, the North Slope Science Initiative, the Arctic Landscape Conservation Cooperative, the North Pacific Research Board, and the North Slope Borough Department of Wildlife Management. Further, the ESP coordinates on logistics and data collection with industry research and monitoring programs in Alaska conducted by BP, Shell Offshore, ConocoPhillips, and others.

PARTNERING WITH THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

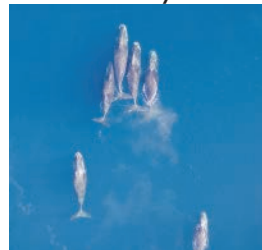
For the entire four decades of its existence, the ESP has developed close scientific collaboration with various offices within NOAA. The ESP has worked closely with NOAA to jointly plan, design, and complete environmental research projects on the Alaska OCS. These projects provide information to support OCS decisions and environmental stewardship under the OCS Lands Act, the National Environmental Policy Act, the Marine Mammal Protection Act, the Endangered Species Act, and other legal mandates. These efforts include state-of-the-art research in both the Arctic and subarctic areas, leading to significant advancements in marine mammal

tagging technology, passive acoustic monitoring systems, understanding the effects of industry-produced sound, and increasing baseline knowledge crucial for monitoring impacts to marine mammals. Key examples of collaboration include the early OCSEAP and BWASP programs discussed below, tagging and feeding studies, and current efforts to synthesize Arctic data analyses across physical, biological, and social research.

Outer Continental Shelf Environmental Assessment Program (OCSEAP)

OCSEAP was established in 1974 through an interagency agreement with NOAA to provide environmental information for oil and gas leasing and development on the Alaska OCS. Research included studies of ice movements and deformation, mammals, birds, fish, benthos, plankton, microbiology, chemistry, oceanography, meteorology, and geology. The program produced 74 volumes of reports. OCSEAP research was downscaled in the mid-1980s but provided a foundation for subsequent ESP studies. For example, the long-term monitoring effort in the Beaufort Sea, known as Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA), had its origins during the OCSEAP era.

Aerial Surveys of Arctic Marine Mammals (ASAMM)



Bowhead whale pod feeding in the Arctic. Photo by Amelia Brower, NOAA.

Another important partnership with NOAA is the current ASAMM study. This study documents annual distribution and abundance of bowhead, right, fin, and gray whales, and other marine mammals in areas of potential seismic survey, exploration, development, and production activities. The roots of ASAMM can be traced to the “Bowhead Whale Aerial Survey Project” (BWASP), which began in 1979 in the U.S. Beaufort Sea

and included aerial surveys in the U.S. Chukchi Sea from 1982 to 1991. Until 1987, the ESP sponsored BWASP in collaboration with the Naval Ocean Systems Center. The ESP then conducted



Arctic ice. Photo by Edgardo a. Foressi giagnorio/Hemera/Thinkstock.

BWASP as an in-house research effort for nearly two decades. In 2008, the ESP established a pair of interagency agreements with NOAA's National Marine Mammal Laboratory to conduct all aspects of the aerial surveys in the Beaufort Sea and to resume surveys in the Chukchi Sea. The two studies were combined into the single ASAMM project in 2011.

PARTNERING WITH THE STATE OF ALASKA AND LOCAL STAKEHOLDERS

Alaska Department of Fish and Game (ADF&G)

The Bowhead Whale Satellite Tracking Project provides just one notable example of successful collaborative engagement between the ESP and the State of Alaska. The project is an unprecedented collaboration among governmental and Alaska Native organizations to document the movements and habitat use of endangered bowhead whales, combining state-of-the-art satellite technology with traditional knowledge and methods of hunting. The study was funded primarily by the ESP, and conducted in partnership with ADF&G, the Alaska Eskimo Whaling Commission, the North Slope Borough Department of Wildlife Management, and the Canadian Department of Fisheries and Oceans, among others. This study has yielded new levels of insight into bowhead biology and the relationships between whales and their environment. The study demonstrated that multi-lateral collaboration involving Native hunters can play a key role in advancing marine mammal science and managing development in the rapidly changing Arctic.

University of Alaska Coastal Marine Institute

The University of Alaska Coastal Marine Institute (CMI) celebrates its 20th anniversary in 2013. This partnership between BOEM and the State of Alaska, through the University of Alaska Fairbanks, collects and disseminates information that addresses local and regional OCS-related environmental and resource issues of mutual interest. Since its inception, the CMI has completed more than 80 studies and leveraged more than \$17 million in ESP funds into \$34 million worth of relevant research through cost-sharing arrangements with a wide range of partners, including state, local, and international

agencies; Alaska Native organizations; academic institutions; non-governmental organizations; and industry.


PARTNERING WITH THE U.S. GEOLOGICAL SURVEY (USGS)

Since 1996, the ESP has worked in direct collaboration with the USGS Alaska Science Center. The ESP and USGS develop a priority list of OCS-related studies that are subsequently conducted by USGS scientists using mutual resources. In recent years, USGS and BOEM have together invested more than \$3 million/year nationally for BOEM offshore work. Recent collaborative efforts have included the study of avian resources, walrus, polar bear demography, and environmental monitoring and mapping. The study *Importance of the Alaskan Beaufort Sea to King Eiders (MMS 2005-057)* is just one example of successful collaboration; it collected information about the distribution of this sea duck to provide a baseline prior to development of OCS oil resources on natural and artificial islands in the Beaufort Sea.

PARTNERING FOR THE FUTURE INCLUDES LOOKING TO THE PAST

The environmental changes seen throughout Alaska, particularly the reduction of sea ice in the Arctic, produce ever-increasing challenges for the ESP. The changing physical conditions have wide-reaching implications for the entire ecosystem, including altered habitat and documented changes in species composition, as well as many socio-economic and subsistence issues. BOEM looks forward to continued collaboration and expanded partnerships for scientific research and monitoring to keep up with the rapid pace of these observed changes. Incorporation of local and traditional knowledge, the practical learning based on observations and personal experience of local residents over an extensive, multi-generational time period, will continue to be one of the keys to success.





Corals occupy a boulder in close proximity to an anemone and sea star in the Atlantic's Norfolk Canyon. Image courtesy of *Deepwater Canyons 2013 - Pathways to the Abyss*, NOAA-OER/BOEM/USGS.

Atlantic Environmental Baseline Studies Pivotal to Marine Planning

BOEM and its predecessors have collected much of the baseline information available on the Atlantic OCS—data that have fed into many important ocean-planning decisions. On the Atlantic shelf, BOEM has been contributing to baseline environmental data since the late 1970s, initially in support of potential oil and gas extraction and more recently to support OCS renewable energy development. The breadth of information collected stretches from the composition of the seafloor and below, to the birds that fly over the water and almost everything in between. Beyond the basic understanding of the environment, information to determine the important social and economic effects of OCS energy development is also collected.

EARLY HISTORY

An important component for many early studies was the development of benchmarks (or baselines). In the **North Atlantic**, the *New England Outer Continental Shelf Environmental Benchmark Study* (1976–1978, [BLM CT6-51](#)) provided a pre-development baseline against which to assess possible human-induced chemical change. The report includes information on hydrocarbons and trace metals in sediment, water column, and selected biota. Additional studies conducted by the U.S. Geological Survey (USGS) analyzed oceanographic processes that affect sediment transport and surficial geological conditions on the shelf and slope of Georges Bank. Yet other studies summarized historical, meteorological, and oceanographic data and provided information concerning environmental processes. This type of information is important for predicting how the environment may be affected by energy development.

In the **mid-Atlantic**, a two-year benchmark monitoring survey completed in 1977 (e.g., [BLM CT5-42](#)) acquired baseline information for the geochemistry, biology, and physical oceanography of the area; it provided seasonal data for variability and processes regulating benthic community structure and levels of chemical constituents in the shelf environment. For

example, studies in the Baltimore Canyon Trough lease area indicated that geological environmental hazards did not warrant withdrawal of lease tracts or preclude petroleum exploration or development, and subsequent studies in the region provided recommendations for mitigating measures of oil-related activities.

The scope and objectives of **South Atlantic** benchmark studies (1977–1979; e.g., [BLM AA550-CT7-2](#)) were equally comprehensive and resulted in maps showing the distribution of reefs, hard grounds, benthic organisms, and bedforms. The research and resulting mapping effort provided information necessary to support lease stipulations for avoiding live-bottom areas.

In the 1980s, the Atlantic Continental Slope and Rise (ACSAR) studies consisted of a set of interdisciplinary baseline studies on the biological, physical, chemical, and geotechnical characterization of the ACSAR. The North Atlantic study collected information to monitor potential changes over time and to estimate the recovery rates of deep-sea benthic communities. In the mid-Atlantic, ACSAR examined pre-drilling biological, geological, and chemical properties of benthic environments near exploratory drilling rigs.

WHALES AND TURTLES

About the same time, the Cetacean and Turtle Assessment Program (CETAP) was initiated to fill data gaps in the distribution, abundance, migration, and habitat of endangered and non-endangered marine mammal and turtle species. Little was known concerning abundance and seasonal distribution of these species at the time of the first leasing activity in the North and mid-Atlantic planning areas. CETAP results from more than 250,000 miles of aerial surveys demonstrated seasonal distribution patterns of cetacean and marine turtle populations in continental shelf waters from North Carolina to Nova Scotia.

Collecting data between October 1978 and January 1982, CETAP helped define critical habitat for the North Atlantic

right whale (*Eubalaena glacialis*), the most endangered large whale species in the area. Researchers learned through CETAP that there was a greater abundance of endangered species throughout the year in the north and mid-Atlantic regions than previously anticipated.

BOEM is actively collecting new information about whales and turtles as well as birds through the ongoing Atlantic Marine Assessment Program for Protected Species (AMAPPS). This multi-agency effort involving BOEM, NOAA, USGS, U.S. Fish & Wildlife Service, and the Department of Defense is seen as the next generation of CETAP but with access to newer technology and experience. The AMAPPS effort includes seasonal vessel and aerial surveys to quantify abundance and distribution and to produce spatially explicit density distribution maps. Results support environmental assessments and programs that monitor risk of extinction and recovery of the species detected during the surveys.

GOING DEEPER – SLOPE, RISE, AND CANYONS

An exciting feature (or features) of the Atlantic OCS are the many canyons along the slope that provide habitat for diverse communities. These canyons are also important habitat for several fisheries including swordfish, marlin, and squid. BOEM explored two of these canyons, Baltimore and Lydonia, extensively in the 1980s. Of greater interest for energy extraction is the slope areas between the canyons. These areas were examined through a series of slope and rise studies on the biological, physical, chemical, and geotechnical characterization on the OCS.

Currently, with NOAA and USGS, BOEM is revisiting the canyon environments focusing on Norfolk, Washington, and Baltimore canyons. This time, archaeological resources are being investigated. The most recent cruise discovered an expansive “bustling field of chemosynthetic mussels” and the presence of gas seeps east of Norfolk Canyon at a depth of about one mile below the ocean surface.

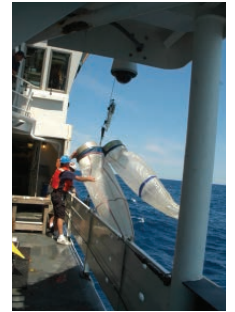
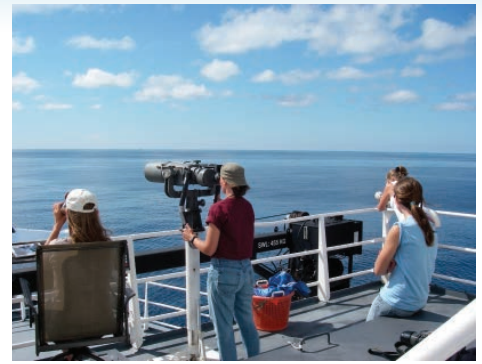
NEW FRONTIER – RENEWABLE ENERGY

The renewable energy industry is rapidly evolving, and BOEM expects that near term projects will focus on the Atlantic OCS. However, OCS renewable energy facilities will have different potential environmental effects than OCS petroleum projects. For example, wind turbines may impact bird species if not properly sited. BOEM is funding several studies to collect historical information, add new information through surveys, and use the latest technology to track the movements of birds.

Technological advances, such as sophisticated submergence facilities capable of high-resolution bottom imagery and extensive sample collection by autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs), have enabled refinement of baseline data collected in early studies.

As technology and our Nation’s energy needs change, baseline studies past, present, and future will continue to play an important role in BOEM’s protection of our Atlantic resources.

Photos Right: Field activities associated with the interagency AMAPPS study. Photos collected by NOAA under NMFS permit 775-1874.



A History of Biological Investigations and Discovery in the Gulf of Mexico

IN THE BEGINNING

The vibrant history of BOEM's Environmental Studies Program (ESP) in the Gulf of Mexico has been shaped, in part, by the fact that the largest oil reserves in the continental U.S. are found in the region. The Bureau is responsible for protecting Gulf ecosystems, including biological resources, while overseeing the responsible extraction of oil and gas. BOEM has been able to maintain this balance by steadily investigating the Gulf environment, even as energy exploration activities moved farther offshore in the early 1990s.

The first quarter-century of biological studies in the Gulf are chronicled in the OCS Report [MMS 2004-015](#), *Minerals Management Service Environmental Studies Program: A History of Biological Investigations in the Gulf of Mexico, 1973–2000* compiled by the renowned deepwater biologist, the late Dr. Robert Avent. Early ESP projects were interdisciplinary assessments of hydrography, geology, chemistry, and biology. These projects and environmental mappings were either in shallow waters on the OCS or, at most, out to the edge of the continental shelf. In the 1970s, primarily in areas with little or no history of oil and gas activity, the data collected were the “benchmarks” against which future impacts might be compared. Since 1985, ESP projects have been focused more on target species or habitats, as well as anthropogenic effects.

SPERM WHALE STUDIES

The Gulf has a diverse marine mammal community, with 28 species known to occur and 21 resident species. As oil and gas exploration moved farther offshore, activities began occurring in regions frequented by deepwater species of cetaceans. One species in particular is the endangered sperm whale (*Physeter macrocephalus*). Sperm whales, which are protected by both the Endangered Species Act and the Marine Mammal Protection Act, are present throughout the Gulf year-round.

The award-winning *Sperm Whale Seismic Study in the Gulf of Mexico*, or SWSS ([MMS 2008-006](#)), investigated possible changes in sperm whale behavior when subjected to anthropogenic noise, particularly from seismic airgun arrays used for OCS petroleum exploration. Data collected showed no horizontal avoidance of sperm whales in the Gulf to seismic survey activities but some reduction in foraging activity during airgun exposure. Additionally, the *Cooperative Research to Study Dive Patterns of Sperm Whales in the Atlantic Ocean* ([MMS 2007-033](#)) compared dive patterns of sperm whales in the Gulf to those in the Atlantic Ocean, where there is no oil and gas activity.

It is also critical to know how seismic noise may affect sperm whale prey species (e.g., squid and small pelagic fish). The *Sperm Whale Acoustic Prey Study* ([GM-09-05](#)) sampled the mid-water pelagic community within the foraging depths of sperm whales and examined the relationships between acoustic backscatter and prey taxonomic composition.

One research program currently ongoing, *Sperm Whales and*



Sperm whale. Photo courtesy of Tim Cole, National Marine Fisheries Service.

Bottlenose Dolphins in the Gulf of Mexico ([GM-11-03](#)), is obtaining data about populations of sperm whales in the eastern Gulf and will provide valuable baseline information about sperm whales from less anthropogenically impacted areas.

CHEMOSYNTHETIC COMMUNITIES

Chemosynthetic fauna (tube worms, mussels, and clams) were discovered at natural hydrocarbon seeps on the continental slope in the Gulf during a 1984 MMS (now BOEM) study, after which the agency began studying these habitats to protect them from offshore oil and gas activity. Later, high-resolution geophysical data were used to investigate the geologic signatures linked to chemosynthetic community habitat. Recent analysis of 15 years of 3-D seismic data reveal more than 21,000 anomalous areas representing likely chemosynthetic habitat in waters more than 300 meters (984 feet) deep. BOEM, NOAA, and industry contractors have confirmed more than 400 of the anomalies as hydrocarbon seeps and hard bottom habitats.

In the 1990s, several chemosynthetic community sites were studied in greater detail and characterized based on the geology, geochemistry, microbiology, and biology of the area. BOEM's studies showed that individual communities were susceptible to mechanical damage from oil and gas activity, and adapted protective measures were quickly implemented. The organisms are very old and grow slowly (e.g., some tube worms can live for more than 200 years). They would take a very long time to recover from any physical damage incurred from seafloor disturbance, if they were able to recover at all.

All of the data collected during the studies of chemosynthetic communities are actively used by BOEM for the protection of the Gulf environment while managing the extraction of

natural resources. Refer to the following studies for more information: *Northern Gulf of Mexico Chemosynthetic Ecosystems Study (MMS 95-0021)*, *Stability and Change in Gulf of Mexico Chemosynthetic Communities (MMS 2002-035)*, and *Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico, (MMS 2009-046)*.

DEEPWATER CORALS

Deepwater corals are long-lived, slow-growing organisms that live on hard bottoms in the Gulf, as do chemosynthetic communities. They can be found on natural habitat, oil and gas platforms, and even on shipwrecks. One of the principal species that forms deepwater assemblages is the tuft coral, *Lophelia pertusa*. Other deepwater corals include the zigzag coral (*Madrepora oculata*), black corals (some more than 2,000 years old), and more than 162 species of gorgonians.

For more than a decade, BOEM has studied deepwater coral communities to gain a better understanding of the processes that control their occurrence and distribution in the Gulf, including measurements of substrate type, population genetics, and growth rates. BOEM has also worked successfully with USGS and NOAA's Office of Exploration and Research (OER) to study deepwater corals, notably leading to the 2011 National Oceanographic Partnership Program (NOPP) Excellence in Partnership Award. In addition, knowledge gained by BOEM's research helped to locate deepwater benthic communities affected by the *Deepwater Horizon* event.

This research will help BOEM protect deepwater corals as it manages offshore oil and gas resources. Refer to the following example studies for more information: *Seafloor Characteristics and Distribution Patterns of Lophelia pertusa and Other Sessile Megafauna at Two Upper-Slope Sites in the Northeastern Gulf of Mexico (MMS 2007-035)*; *Characterization of Northern Gulf of*

Mexico Deepwater Hard Bottom Communities with Emphasis on Lophelia Coral (MMS 2007-044); and *Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard-Bottom Habitats, with Emphasis on Coral Communities: Reefs, Rigs, and Wrecks – Lophelia II (BOEM 2012-106)*.

LOOKING FORWARD

Moving into the future, BOEM plans to build upon its history of successes in the Gulf during the last 40 years, as the Nation continues its quest for energy. BOEM is excited about the waters yet unexplored and the discoveries yet to be uncovered through its regional Environmental Studies Program.



Close-up image of *Lophelia pertusa* coral at a depth of 451 meters (1,480 feet) during a Jason II ROV dive in 2009 co-funded by BOEM and NOAA OER. *Lophelia II 2009: Deepwater Coral Expedition: Reefs, Rigs, and Wrecks*.

RECENT GULF OF MEXICO REGION AWARDS

- 2004 DOI Cooperative Conservation Award – Sperm Whale Seismic Study in the Gulf of Mexico
- 2006 DOI Cooperative Conservation Award and 2007 NOPP Excellence in Partnership Award – Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: Artificial Reef Effect in Deep Water
- 2007 DOI Cooperative Conservation Award – Deepwater Program: Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico
- 2009 DOI Partners in Conservation Award – Flower Garden Banks Long-Term Monitoring
- 2010 DOI Partners in Conservation Award – History of the Offshore Oil and Gas Industry in Southern Louisiana
- 2011 DOI Partners in Conservation Award – Archaeological Analysis of Submerged Sites in the Gulf of Mexico Outer Continental Shelf
- 2011 NOPP Excellence in Partnership Award – Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities: Reefs, Rigs, and Wrecks (*Lophelia II*)

From Baseline to Beyond: 40 Years of Pacific Environmental Studies

Over its 40-year history, the Environmental Studies Program (ESP) in the Pacific Region funded a diverse array of scientific research about the marine, coastal, and human environments offshore California, Oregon, Washington, and Hawaii. Since the program's inception under the Bureau of Land Management (BLM) in 1973, the region conducted more than 300 studies valued at more than \$140 million. While most of these studies informed decisions about oil and gas activities on the California Outer Continental Shelf (OCS), recent priorities have expanded to address renewable energy throughout the region. The evolution of the Pacific ESP can be roughly divided into four overlapping phases that chronicle the region's energy activities and changing information needs.

BASELINE IN THE BIGHT (1973–1983)

The Pacific ESP took shape in the aftermath of the 1969 Santa Barbara oil spill amid a backdrop of public concern over accelerating oil and gas development offshore southern California. Need for baseline information about environmental conditions throughout the Southern California Bight (the area between Point Conception and the U.S.-Mexico border) drove early studies. Indeed, the first two products of the Pacific ESP documented the current state of knowledge and laid the groundwork for future research. The resulting "BLM Southern California Baseline Studies," conducted in the mid-1970s, produced an unprecedented suite of information about virtually every facet of the marine and coastal environments in the Bight. Continuing into the early 1980s, ecological baseline studies of the Northern and Central California OCS were conducted in anticipation of oil and gas leasing in those areas. That research included the first comprehensive surveys of marine mammals and seabirds.



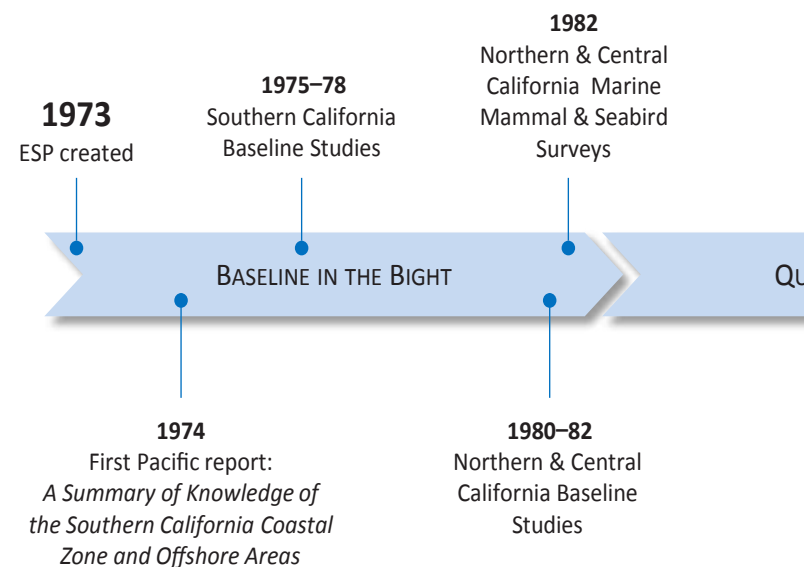
BOEM scientists prepare for a submersible dive beneath oil platforms off southern California.

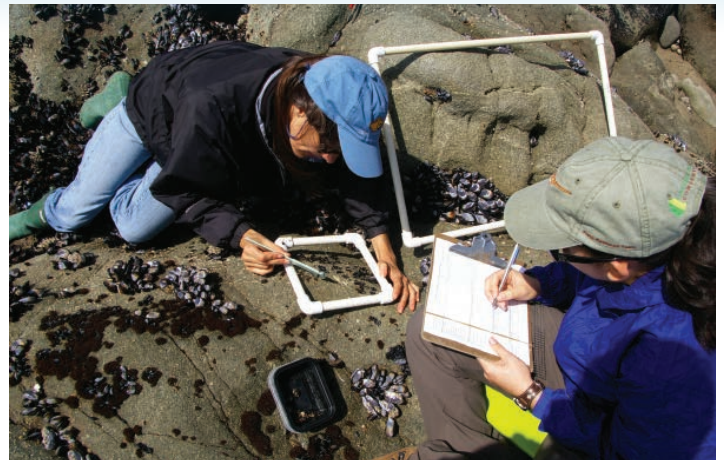
QUANTIFYING IMPACTS (1983–1993)

With continued oil development off southern California and the 1990 moratorium on new leasing in the region, Pacific needs shifted from acquiring pre-lease baseline information to assessing ongoing impacts of production. To meet these needs, emissions and discharges from platforms were measured to determine impacts on air and water quality; ocean circulation data were acquired and used to develop predictive oil-spill models; and socioeconomic studies were conducted to identify possible effects on coastal communities. A multi-disciplinary, multi-phase study to monitor potential environmental changes near platforms (the California OCS Monitoring Program or CAMP) took place during this period, along with the first of several platform ecology studies. In 1989, the Minerals Management Service (MMS, now BOEM), State of California, and University of California (UC) created the Southern California Educational Initiative (SCEI), a cooperative research and research-training program focused on long-term environmental, social, and economic consequences of offshore oil and gas production. The successful initiative fostered innovative, high-caliber, and cost-effective science that continued through 2004.



Common dolphin in the Santa Barbara Channel. *Photo courtesy of Greg Sanders.*





BOEM scientists determine the diversity and cover of intertidal organisms. *Photo courtesy of Ralph Vasquez.*

Above left: Black Storm-Petrels and Least Storm-Petrels take flight in the Southern California Bight. *Photo courtesy of David Pereksta.*

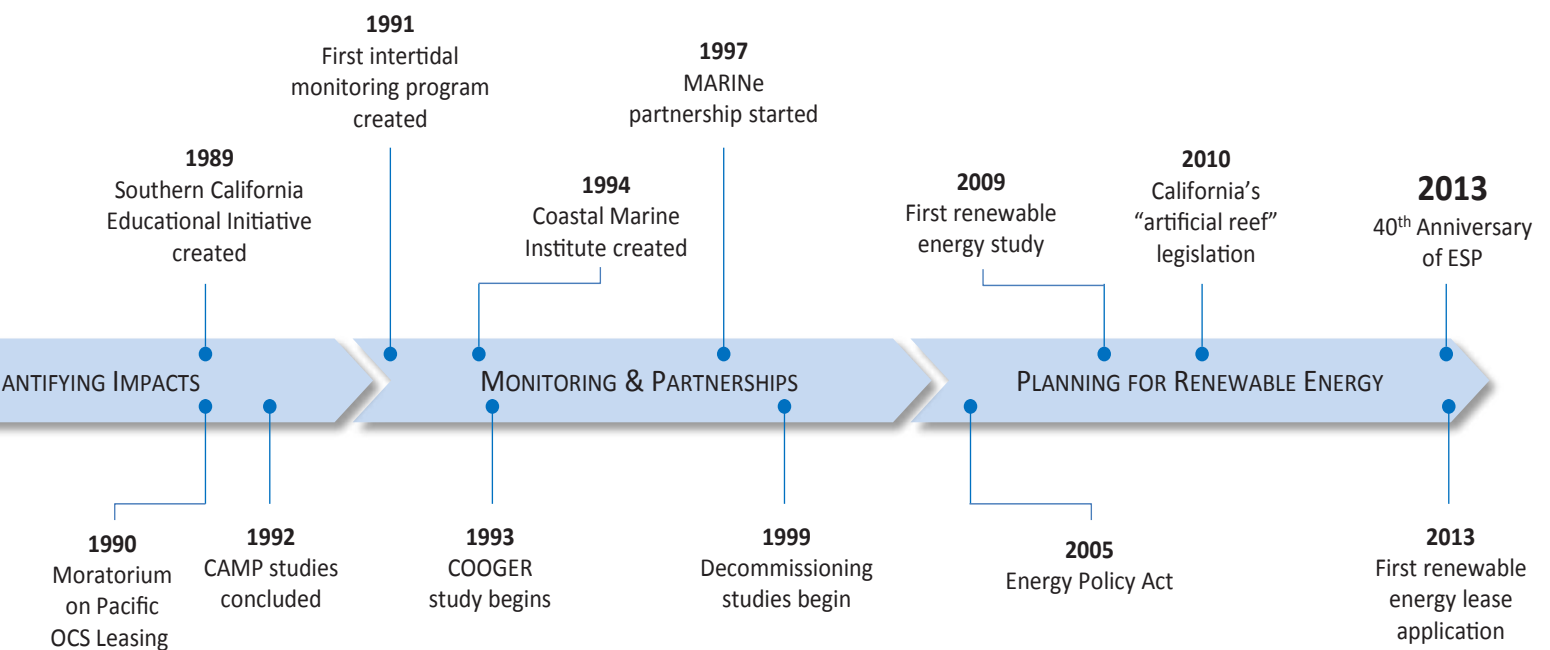
MONITORING & PARTNERSHIPS (1993–2003)

In the early 1990s the region launched long-term studies to monitor rocky intertidal sites adjacent to OCS oil and gas operations, including several in-house studies and the Multi-Agency Rocky Intertidal Network (MARINe). MARINe is the largest long-term monitoring program on the Pacific coast; its partners have raised awareness of intertidal ecosystems and generated decades of data that are accessible in a common database, enabling comparative analysis across time, space, and species. During this decade, MMS initiated the California Offshore Oil and Gas Energy Resources (COOGER) study in response to growing concerns about cumulative impacts of offshore oil development on coastal communities. The six-year, cooperative effort with State and local governments and the oil and gas industry produced extensive information for future decisions regarding oil and gas activities. The Coastal Marine Institute (CMI), a university research partnership similar to SCEI, was created in 1994. CMI studies also focused on long-term consequences of offshore oil and gas production. The Institute stimulated considerable new research by UC faculty and students until it ended in 2007, and was instrumental in training students in the application of science in decision making. At the turn of the century, Pacific platforms were thought to be near the end of their economic life, prompting studies about the ecological and economic impacts of decommissioning. Other studies documented increased marine life near platforms, confirming their ecological value as artificial reefs; those findings fueled political debate and led California to enact legislation in 2010 that allows decommissioned platforms to be turned into reefs.

PLANNING FOR RENEWABLE ENERGY (2003–2013)

With the passage of the Energy Policy Act of 2005, the scope of the Pacific ESP has expanded to address the emerging renewable energy program, including wind and wave energy across the entire Pacific coast and Hawaii. By 2009, the first Pacific studies informing renewable energy were underway, and an increasing proportion of ESP funds and effort are directed to that program. As of June 2013, 26 Pacific studies relate to renewable energy (with 6 studies complete and 20 ongoing or planned). A number of these are baseline studies to characterize the environmental conditions, biota, and cultural resources in prospective areas for wind- or wave-energy development.

From the baseline studies of 40 years ago to the baseline studies today, the Pacific ESP provides a rich history for viewing the changing nature of offshore energy and the information needed to support its sound development.



Sustained Commitment to OCS Stewardship Through Long-Term Environmental Monitoring



Research diver taking quantitative photos of corals at the Flower Garden Banks as part of the Long-Term Monitoring Program. Photo courtesy of Gregory Boland.

BOEM is involved with several long-term monitoring programs that provide excellent examples of sustained commitment to OCS stewardship. These efforts include the long-term monitoring of Flower Garden Banks coral reefs, MARINE (Multi-Agency Rocky Intertidal Network), bowhead whale studies, and contributions to the Smithsonian collections. These studies have successfully implemented the Outer Continental Shelf Lands Act (1953), which mandates: “Subsequent to the leasing and developing of any area or region, the Secretary shall conduct such additional studies to establish environmental information as he deems necessary and **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...”

The Flower Garden Banks (FGB) Long-Term Monitoring Program at the FGB National Marine Sanctuary is widely believed to be the longest continuous coral reef monitoring program in the world, beginning as early as 1975 and conducted annually without interruption since 1988. In 2009, the program won a DOI Partners in Conservation Award, an award established to recognize individuals and organizations that have produced outstanding conservation achievements to foster collaboration and partnerships to further the mission.

Another BOEM ongoing monitoring program is the Multi-Agency Rocky Inter-tidal Network, or MARINE. As part of more than 100 sites along the Pacific coast from Canada to Mexico, 32 rocky inter-tidal sites are monitored on the mainland shore adjacent to OCS production facilities (some sites since the 1970s) allowing BOEM to directly assess impacts to shoreline resources and differentiate between naturally caused and other anthropogenic impacts, such as those from OCS oil and gas activities. The MARINE program was awarded the 2012 DOI Partners in Conservation Award.

In addition to these programs, BOEM has conducted the Bowhead Whale Aerial Survey Project since 1979. It targets

the autumn migration of bowhead whales through the U.S. Beaufort Sea, as well as documents the distribution and relative abundance of a variety of other whales. The project is aimed at providing a wide-area context for understanding marine mammal ecology in the U.S. Arctic, helping inform management decisions, and interpreting results of other smaller-scale studies. The DOI Partners in Conservation Award was received in 2010 for the Bowhead Whale Satellite Tracking Project, an unprecedented collaboration among governmental and Alaska Native organizations to document the movements and habitat use of endangered bowhead whales combining state-of-the-art satellite technology with traditional knowledge and methods of hunting.

BOEM has also had a program since 1979 with the Smithsonian Institution’s National Museum of Natural History to archive invertebrate specimens collected through BOEM studies. The BOEM specimens make up nearly 20 percent of the invertebrate collection records and in some categories, like *annelida* (worms), BOEM specimens represent the majority of the collection. Particularly important and amazing is the large number of specimens transferred, including approximately 400 species new to science.

FOR MORE INFORMATION:

Flower Garden Banks National Marine Sanctuary
<http://flowergarden.noaa.gov/science/eastwestmonitor.html>

Multi-Agency Rocky Intertidal Network
<http://www.marine.gov/>

Bowhead Whale Aerial Surveys
<http://www.afsc.noaa.gov/NMML/cetacean/bwasp/>

Smithsonian National Museum of Natural History: Bureau of Ocean Energy Management (BOEM)
<http://invertebrates.si.edu/boem/boem.htm>

Spotlight on Our Science Team



Coastline. Photo by Polka:Dot Images/Polka Dot/Thinkstock.

The BOEM science team shares a common vision for active stewardship of the OCS environment. Part of BOEM's important mission is to develop and implement the results of research on OCS impacts of our regulated activities on the human and ecological aspects of the ecosystem. This is not a role that we at BOEM take lightly. Our Environmental Studies Program is over 200 BOEM scientists strong, across all regions, offices, programs, and activities. Our scientists are dedicated public servants who go above and beyond to ensure that national, regional, and program needs are represented as we develop and conduct our studies.

The diversity of scientists in BOEM and their accomplishments is a great strength to our interdisciplinary program. Having economists, oceanographers, sociologists, ecologists, meteorologists, and other subject matter experts ready, willing, and able to work together to address the important science and policy issues that confront BOEM is an asset of which we are all proud. A highlight of our program is that many of BOEM's scientists are recognized as leaders in their disciplines, regularly publishing in peer-reviewed literature, writing/editing books, and presenting at major scientific conferences.

The quality and integrity of BOEM science continues to be beyond reproach. The core tenets of the DOI Policy on Scientific and Scholarly Integrity

are evident throughout BOEM's science programs, and our goals are highly aligned with this policy, which ensures that: (1) decisions are based on science and scholarship and are respected as credible, (2) science is conducted with integrity and excellence, (3) the culture of scientific and scholarly integrity is enduring, (4) scientists and scholars are widely recognized for excellence, and (5) employees are proud to uphold the high standards and lead by example.

BOEM has always looked both inwardly and outwardly to find the best science and scientists to meet mission needs. This has been evident in the countless partnerships that we have participated in over the years. We actively seek ways to increase our partnerships to leverage resources and ensure the greatest science and value for the American people. Partnerships with federal agencies such as NOAA, USGS, U.S. Fish & Wildlife Service, and others (directly or through the National Oceanographic Partnership Program), numerous states, non-governmental organizations, and private research entities have only strengthened our program.

Looking forward to the next 40 years of the ESP, we can be proud of the path we have put ourselves on through hard work and dedication as we keep working to ensure the strength, value, and continued success of our program in meeting the scientific and stewardship needs of BOEM and the Nation.



The BOEM science team at work, including (left to right): HQ staff participating in the Bureau's 2011 Science Day, the dive team at sea in the Gulf of Mexico (2004), participation in the multi-agency Deepwater Horizon Operational Science Advisory Team (OSAT, 2010), and at-sea sample analysis during a research cruise in the Gulf of Mexico (2009).

BOEM OCEAN SCIENCE

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New Waves

Late-Breaking News & Information

OCS Scientific Committee Advises on Environmental Studies Program

Leading scientists from around the Nation gathered in New Orleans May 14–16, 2013, to review the environmental research that will help shape the future of OCS energy development for the United States.

The OCS Scientific Committee, a public federal advisory committee for BOEM, is a 15-member panel of distinguished scientists representing diverse scientific fields such as marine biology and ecology, physical sciences, and social sciences. This independent committee of scientists advises the Department of the Interior on its OCS energy environmental research program.

As part of the important role it plays in assisting the development of BOEM's scientific research program, the committee completed three days of meetings with researchers from BOEM to review plans for future studies on the OCS.

During the meeting, scientists from BOEM's Environmental Studies Program, including the Pacific, Alaska, and Gulf of Mexico regional offices and the Office of Renewable Energy Programs, presented updates of current studies as well as profiles for the studies that are being proposed for funding in the next two years. In breakout sessions

covering specific scientific topics and emerging issues, subcommittees of subject matter experts discussed the focus and relevance of the research and data being produced.

Subcommittee members then evaluated the information that had been presented about the critical research needed, and later reported their findings to the full committee and all attendees during a general session. BOEM officials will consider the recommendations made during this meeting, along with the continuing work done by the various subcommittees during the year, to evaluate the scope, direction, and emphasis of future research.

The dedicated work and guidance of the OCS Scientific Committee is an essential component of BOEM's mission to obtain the best scientific information available in order to

make informed decisions in managing the Nation's OCS energy and marine mineral resources in an environmentally safe manner.



BOEM Science Advisor, Mr. Robert LaBelle; Chief of BOEM's Division of Environmental Sciences, Dr. Rodney Cluck; and Scientific Committee Chair, Dr. Lorrie Rea (Alaska Dept. of Fish and Game) at the recent Scientific Committee Meeting in New Orleans.