BOEM OCEAN SCIENCE

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

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BOEM's Office of Renewable Energy Programs Update

BOEM OCEAN SCIENCE

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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
Installation of a wind turbine at the Block Island Wind Farm, offshore Rhode Island.

All photos courtesy of the Bureau of Ocean Energy Management unless otherwise noted.

Publication services provided by The C3 Group and Schatz Strategy Group.

Frequently Used Abbreviations

EMF	electromagnetic field
FAD	fish aggregating device
GIS	Geographic Information System
IGRE	Intergovernmental Renewable Energy (Task Force)
MHF	marine hydrokinetic facility
OCS	Outer Continental Shelf
OFW	offshore floating wind
RODEO	Real-Time Opportunity for Development Environmental Observations
WEA	Wind Energy Area

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For More Information

Check out the Bureau of Ocean Energy Management website at **www.boem.gov**.

The Acting Director's Message

In this issue, we are providing an update on our renewable energy programs. We have made significant progress in recent years, yet there is still much work to do. To date, we have awarded 11 commercial wind energy leases, 9 of which were issued via 5 competitive lease sales (i.e., auctions) and 2 were issued non-competitively. Competitive lease sales have generated more than $16.4 million in winning bids for more than 1.18 million acres in federal waters. In December, we announced the completion of the Nation's sixth competitive lease sale for renewable energy in federal waters offshore New York, for which the provisionally winning bid was over $42 million. In 2016, we also witnessed the Nation's very first offshore wind farm becoming operational in Rhode Island state waters off the coast of Block Island in the Atlantic.

Many studies contributed to this progress and we will explore some of this scientific underpinning on the following pages. This issue covers a wide range of studies, everything from fish studies that help us track the habitat and movement of fish that are so vital to our economy, to research on the impact of wind energy on sea birds. We also take a look at ocean modeling that is used to manage siting issues that arise long before a renewable energy lease sale is held.

In one article, we will take you to a RODEO—the acronym for Real-Time Opportunity for Development Environmental Observations. The goal of the RODEO study is to acquire real-time observations of the construction and initial operation of wind facilities. RODEO measures visual effects, sound produced by wind energy activities, and the way that anchoring or cable installation disturbs the seafloor, using various types of monitoring equipment.

The future is bright for offshore renewable energy. Please enjoy this issue of *BOEM Ocean Science*.

– Walter D. Cruickshank

Installing a wind turbine at the Block Island Wind Farm, Rhode Island.

For More Information

BOEM's Environmental Studies Program
http://www.boem.gov/Studies/

BOEM's Environmental Studies Program Information System (ESPIS)
http://marinecadastre.gov/espis

BOEM's Renewable Energy Program: Major Strides for Offshore Wind in the United States

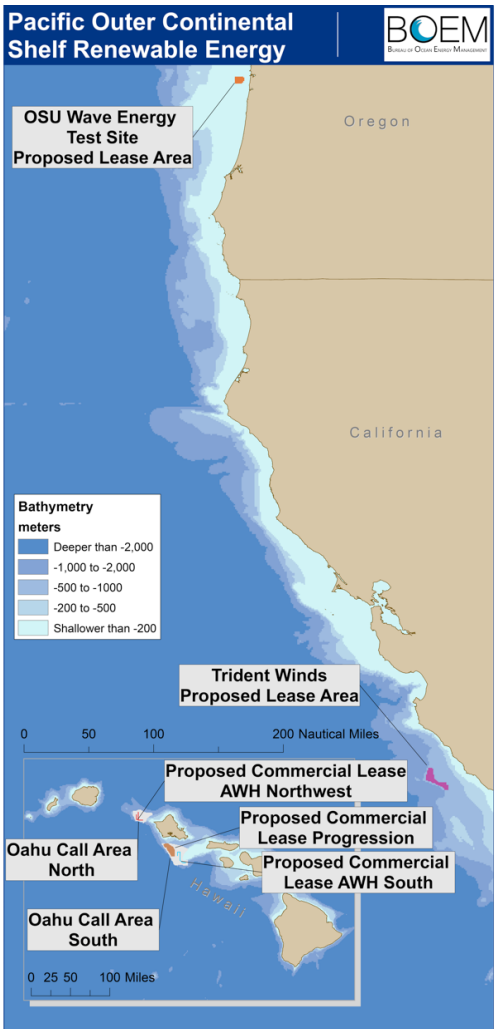
Commercial wind energy is no longer simply an aspiration for a sustainable energy future. Development of renewable energy is of critical importance to the Nation and it is now a reality onshore and offshore. The Block Island Wind Farm, located in Rhode Island waters, is now the United States' first offshore wind facility. This project may set the stage for a long-awaited and even more expansive development of wind energy facilities on the Federal Outer Continental Shelf (OCS).

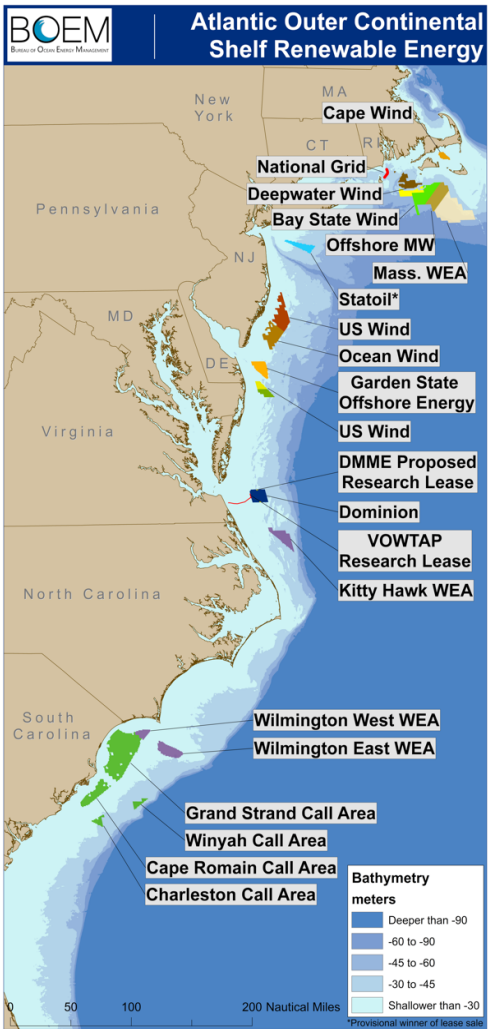
Because OCS wind is an abundant source of environmentally friendly domestic energy, it is well-positioned to contribute to the economic growth and energy independence of the Nation. According to an analysis conducted by the National Renewable Energy Laboratory (NREL), the U.S. OCS wind resource is robust, abundant, and regionally diverse, allowing for offshore wind development that can be located near congested load centers with some of the highest electricity rates in the Nation.

The Energy Policy Act of 2005 gave the Bureau of Ocean Energy Management (BOEM) responsibility to oversee renewable energy development on the OCS by granting leases, easements, and rights-of-way for such projects. The Energy Policy Act requires that BOEM ensure OCS renewable energy activities are carried out in a safe and environmentally responsible manner that provides a fair return to the United States for the use of the OCS. On April 22, 2009, BOEM published the regulatory framework to govern the OCS renewable energy program. Since that time, BOEM has established Intergovernmental Renewable Energy (IGRE) Task Forces, identified wind energy areas (WEAs) off of seven states, and awarded wind energy leases off the Atlantic coast covering more than one million acres. To date, BOEM has established 11 Task Forces in the Atlantic and 3 in the Pacific. These Task Forces include Federal and State agencies, local governments, and federally recognized tribes to promote open dialogue and data-sharing, and ensure that concerns are identified as early as possible to eliminate or reduce potential environmental and multiple-use conflicts. BOEM engages its Task Forces through its planning, leasing, and plan review procedures to discuss important topics such as WEA delineation, auction processes, planning and operations oversight, environmental compliance and safety monitoring, and decommissioning of facilities.

BOEM has 11 leases along the East Coast for the possible development of commercial-scale wind facilities on the OCS, and a lease pending for future development offshore New York. BOEM also plans to conduct another auction in March of 2017 for a WEA offshore North Carolina (Kitty Hawk). With this lease in place, every state adjacent to the OCS from Massachusetts to North Carolina will have at least one area available for commercial wind farm development.

In the past year, interest in OCS wind energy has emerged in the Pacific Ocean. This includes an unsolicited proposal for a wind farm off the coast of California as well as three offshore





Hawaii. In October 2016, the State of California joined with BOEM to convene an IGRE Task Force to facilitate development of OCS wind resources.

With a number of leases in the Atlantic now in the hands of industry, BOEM has been actively reviewing lessees' plans for OCS site characterization surveys and wind resource assessment activities, the results of which will be incorporated into future construction and operations plans.

Ensuring that renewable energy resources are developed in a responsible manner is a priority for BOEM. BOEM's bureau-wide Environmental Studies Program (ESP) provides support for this effort by funding studies that inventory and compile available information, identify knowledge gaps, and analyze potential impacts to natural and cultural resources from OCS renewable energy development.

The Office of Renewable Energy Programs (OREP) has funded 32 studies (6 in progress) that focus on technical knowledge gaps and informing best management practice recommendations. Currently, a study investigating risk and evaluating identification methods for unexploded ordinance (UXO) and munitions of explosive concern (MEC) is nearing completion. The study will help BOEM delineate areas of higher risk in the vicinity of designated WEAs and active leases or grants as well as develop best management practices for identifying UXO or MEC that pose a safety risk during development activities.

Year in Review

- In May, the U.S. took an important step toward increasing the use of offshore wind resources. Building on ongoing talks between the United States and Denmark regarding offshore wind, BOEM, on behalf of the United States, signed a Memorandum of Understanding (MOU) with the Government of Denmark to strengthen cooperation and information sharing on wind energy. The MOU promotes information sharing, best practices, and policy initiatives to support the development and regulation of OCS wind energy resources.
- In June, in consultation with the Hawaii IGRE Task Force, BOEM issued a Call for Information and Nominations to gauge the offshore wind industry's interest in acquiring commercial wind leases in two areas spanning approximately 485,000 acres of submerged lands in Federal waters offshore Oahu.
- In August, BOEM, through the Pacific OCS Region office, issued a Request for Interest regarding potential wind energy leasing offshore California in which BOEM received an additional expression of competitive interest.
- In September, to facilitate the responsible development of offshore wind energy in the U.S., the U.S. Department of Energy (DOE), through its Wind Power Program, and the U.S. Department of the Interior (DOI), through BOEM, jointly drafted an updated offshore wind national strategy. This strategy identifies the gaps that need to be addressed in order to facilitate the deployment of offshore wind and provides a set of actions that DOE and DOI will undertake to address these gaps and help the Nation realize the benefits of offshore wind development.
- In December, BOEM conducted a highly successful lease sale for more than 79,000 acres offshore New York. The winning bid exceeded $42 million and signaled a new level of interest in Atlantic wind energy development.
- Just recently, BOEM announced a Final Sale Notice for commercial leasing of approximately 122,405 acres offshore North Carolina (Kitty Hawk). Nine bidders are qualified for the sale to be held in March of 2017.

A Note of Thanks

With the change in administration, our Bureau Director, Abby Hopper, has moved on. She was highly dedicated to our mission providing thoughtful analysis, clear direction, and identification of objectives. She made a significant and positive impact on the Renewables Program. During her tenure, we executed the first White House-sponsored Summit on Offshore Wind; conducted lease sales in Massachusetts, New Jersey, and New York; advanced international cooperation; and provided a well-defined strategy for the future. She will be missed.

The Bright Future

The achievements of the past few years combine favorably with industry-wide cost reductions and state incentives to help ensure the U.S. will have a bright OCS renewable energy future. However, realizing the potential of OCS wind energy in the United States will require addressing key challenges.

We look forward to working closely with our Federal, State, local, and tribal partners as well as industry, environmental organizations, and the public to meet these challenges.

From the inception of the Federal OCS Renewable Energy Program, the forecast for OCS renewable energy activities has been optimistic. Now, with a clearly defined leasing and review process in place, appropriate technology available, favorable economics, leases in hand, and actual steel in the water, we are making that future a reality.

– Jim Bennett, Chief, Office of Renewable Energy Programs

For More Information

BOEM's Ongoing Renewable Energy Studies

http://www.boem.gov/Renewable-Energy-Ongoing-Studies/

BOEM's Completed Renewable Energy Studies

http://www.boem.gov/Renewable-Energy-Completed-Studies/

Fisheries Studies in the Atlantic and Pacific Regions

BOEM is concerned with the potential impacts on commercial and protected fish in wind energy development areas, and has invested in studies to assess these potential impacts on various species. Many studies are currently underway with a focus on using acoustic telemetry to track the movement of fish species. BOEM has awarded four fish telemetry projects offshore New York, Delaware, Maryland, and Virginia over the past year. These projects, in conjunction with mapping habitats in the Wind Energy Areas (WEA), will significantly increase our understanding of seasonal fish movements and habitat selection on the OCS in advance of offshore wind energy activities.

Assessing Atlantic Sturgeon and Other Fish Habitat Usage

BOEM has invested more than $1.5 million in four fish telemetry research projects in the mid-Atlantic. These studies will advance BOEM's understanding of how fish use the offshore habitats where future OCS energy projects may be developed. The results can help inform seasonal movement as well as habitat affinity of different species. The four projects are:

- Endangered Atlantic Sturgeon Habitat Use in Mid-Atlantic Wind Energy Area (Naval Facilities Engineering Command, Atlantic)
- Monitoring Endangered Atlantic Sturgeon and Commercial Finfish Habitat Use Offshore New York (State University of New York at Stony Brook)
- Movement and Habitat Selection by Migratory Fishes within the Maryland Wind Energy Area and Adjacent Sites (University of Maryland Center for Environmental Science)
- Occurrence of Commercially Important and Endangered Fishes in Delaware Wind Energy Area using Acoustic Telemetry (University of Delaware and Delaware State University)

Atlantic sturgeon are a priority species due to their Federal endangered status throughout most of the Atlantic. This project will help managers to better understand their offshore winter habitat usage. Similarly, the seasonal movement of commercially important species such as Atlantic striped bass, black sea bass, and skates are not well understood in relation to BOEM's areas of interest in the mid-Atlantic. This research will inform environmental impact assessments for OCS renewable energy and marine minerals extraction.

Working with Fishermen in Baseline Data Collection

The "Southern New England Cooperative Ventless Trap Survey" was initiated to develop a baseline for measuring the cumulative effects of offshore development (offshore Rhode Island and Massachusetts) and to assess the lobster stock in southern New England. This area boasts one of the most valuable fisheries in southern New England, producing nearly $70 million in revenue annually and sustaining support businesses such as trap-builders, gear suppliers, bait and ice dealers, shipyards, fuel companies, engine sales and repair businesses, and marine electronic retailers. BOEM-funded research brought in Rhode Island commercial lobster fishermen to assess lobster stock and fill data gaps left by State lobster surveys.

The "Collaborative Fisheries Planning for Virginia's Offshore Wind Energy Area" study, a cooperative agreement between BOEM and the Commonwealth of Virginia, directly solicited input from local fishing communities to: 1) establish a process for a two-way exchange of information; 2) create maps of important fishing areas; and 3) further develop best management practices.

Meetings were held to share current information about offshore wind energy and allow for questions and answers. The most commonly expressed concern was regarding access to fishing areas within and around the leased area.

To create accurate maps, the researchers invited fisherman

Recreational fishing near the Block Island Wind Farm offshore Rhode Island. *Photo by Brian Krevor, BOEM.*

to share their chart plotter data and react to fishing maps created through other projects.

The final outreach effort involved presenting and evaluating best management practices. These efforts represent how BOEM is working to resolve perceived conflicts through education, collection of refined data, and collaboration with fishermen. The study was highlighted in the Mid-Atlantic Regional Ocean Action Plan as a successful collaboration between Federal and State governments and stakeholders.

Creating best management practices (BMP) involved five areas of discussion:

1. Communications framework
2. Siting, micrositing, design, and construction
3. Navigation, access, and safety
4. Environmental monitoring
5. Mitigation

These detailed BMPs were shared and discussed with commercial and recreational fisherman in open discussions regarding offshore development plans with respect to the needs of the fishing industry.

Examining Effects from Electromagnetic Fields

Looking to the Pacific, the BOEM-funded study "Renewable Energy in situ Power Cable Observation" examined the potential effects of energized, seabed-deployed power cables on marine organisms. Specifically, this study sought to determine the differences among fish and invertebrate communities in cable habitats vs. soft seafloor habitats without cables; whether electromagnetic fields (EMF) attract or deter species such as sharks and rays that are typically electro-sensitive; the strength, spatial extent, and variability of EMFs along energized and unenergized cables; and the potential effectiveness of cable burial. The study was divided into two areas: inshore waters (10–14 m [33–46 ft]) and offshore waters (76–213 m [250–699 ft]).

Key findings:

- Neither inshore nor offshore assemblage differences were significant in fish and invertebrates. However, there were some statistically significant differences in offshore invertebrate densities between energized and unenergized cables, as well as depth differences.
- No compelling evidence was found to indicate EMF produced by the energized power cables in this study were either attracting or repelling fish.
- The strength of the EMF along the energized cable was relatively stable over time and along its length. The EMF produced by the energized cables diminishes to background levels about one meter away from the cable. Both the pipe and natural habitat sites had extremely small or undetectable EMFs.
- Given the rapidity with which the EMF produced by the energized cables diminishes and the lack of response to that EMF by the shallower fish and invertebrates, cable burial would not appear necessary strictly for biological reasons.

Another study observing the effects of EMF is "EMF (Electromagnetic Field) Impacts on Elasmobranch and American Lobster Movement and Migration." The objective of this research was to determine the actual emissions associated with High Voltage Direct Current (HVDC) cables and the response of the American lobster and elasmobranch species (sharks, rays, and skates) to this exposure.

In August 2015, precise EMF measurements were collected using purpose-built equipment to survey the Cross Sound Cable that connects the grids of New England and Long Island, NY. Field experiments were conducted over the cable using a mesh enclosure. Locally acquired lobster and skates were implanted with transmitters to track their movements and detect real-time, fine-scale movements during a 24-hour period of exposure. Experiments were repeated several times to collect sufficient data to evaluate small effects.

Future Direction

OCS renewable energy is an ocean use that is continuing to develop as a power supply on the Atlantic and Pacific coasts. These technologies will continue to evolve but basic impact-producing factors such as construction noise, physical habitat alteration, and space-use conflicts with other ocean users will continue to drive BOEM studies for the foreseeable future.

BOEM will maintain efforts to evaluate the potential impact of these technologies on the fishing industry and will continue to establish open communication with the fisheries stakeholders.

– Janet Purdy, Schatz Strategy Group

For More Information

Southern New England Cooperative Ventless Trap Survey
https://www.boem.gov/Ventless-Trap-Study-Profile/

Collaborative Fisheries Planning for Virginia's Offshore Wind Energy Area
https://www.boem.gov/VWEA-Final-Report/

Renewable Energy in situ Power Cable Observation
https://marinecadastre.gov/espis/#/search/study/26953

EMF Impacts on Elasmobranch and American Lobster Movement and Migration
https://marinecadastre.gov/espis/#/search/study/100067

Endangered Atlantic Sturgeon Habitat Use in Mid-Atlantic Wind Energy Area
https://marinecadastre.gov/espis/#/search/study/100087

Are You Ready for the RODEO?

BOEM is carefully watching the development of the first OCS wind facility in the United States. Five wind turbines were installed near Block Island, Rhode Island in two phases beginning in the summer of 2015. With the responsibility for the approval of construction and operations plans submitted by developers, BOEM is learning from the first activities of this kind along the U.S. coast. Lessons learned and data collected from this project will guide BOEM in managing future OCS wind energy development.

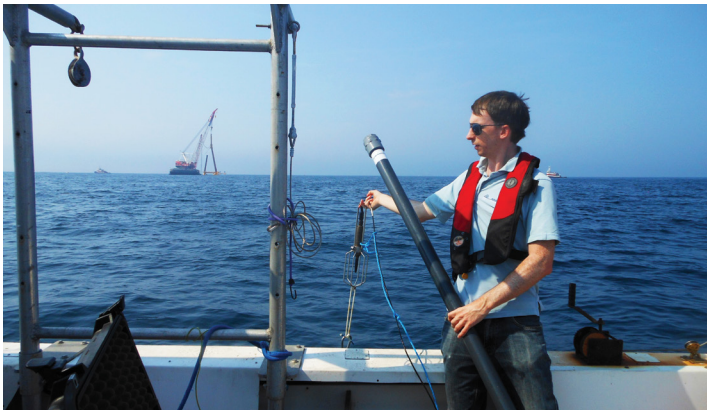
The objective of BOEM's study "Real-time Opportunity for Development Environmental Observations (RODEO)" is to acquire real-time observations of the construction and initial operation of wind facilities to aid the evaluation of environmental effects of future facilities. Analyses of the environmental consequences of development require knowledge of the duration and extent of the activity. An analyst typically relies on the best available information and assumptions based on previous experience. For OCS wind development, there is no previous experience in the U.S., therefore the analyses and subsequent mitigation measures are based on an educated guess. These analyses will benefit from real-time, independent observations made during actual construction of the Block Island wind turbines.

Questions initially raised regarding OCS wind energy projects focused on noise levels, disturbance of the seabed, and visual impacts from shore. Some of these questions were answered in the summer of 2015 when BOEM contractors used hydrophones to listen to the sound of pile driving during the initial phase of installing the foundations. Data is not yet published, but the sound could be heard as far away as 25 miles (40 km).

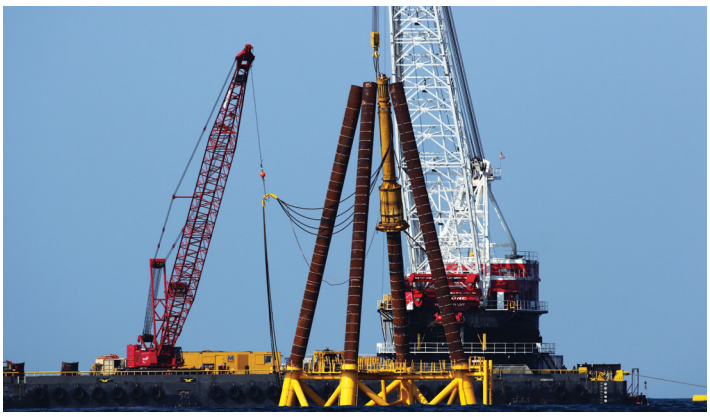
BOEM researchers are also evaluating the area for seafloor disturbance and the recovery time through a series of multi-beam surveys that image the seafloor by projecting sound at different angles and then recording how long it takes to return to the receiver. Data indicates the area of disturbance was small and BOEM will continue to evaluate the length of time for seafloor recovery.

Additionally, during the installation of the cable from the wind facility to the mainland, research focused on measuring the rate of sediment particle settling after seafloor disturbance by the jet plow. Water samples were collected and optical devices were used to measure the density of particles. Initial reports indicated that the jet plow did not create a cloud of particles. Recovery of the seafloor after the installation will also be documented.

While the next phase of development was taking place, observations were made during the installation of the tower, nacelle, and blades on the turbines. Observations recorded events as they occurred to understand the impacts as construction took place. Other data collected included documenting the number and types of vessels used and the length of time for construction events.



Deploying an acoustic monitor near the Block Island Wind Farm during the RODEO study.



Construction of a wind turbine at the Block Island Wind Farm.

Looking Ahead

The construction of the first turbine in the U.S. offshore environment offers an opportunity to address some of the environmental questions that are of concern to the public. Many Federal agencies have mandates to protect the environment and will need to know more precisely what wind development will involve. Through a collaborative effort with other Federal and State agencies, this study of the construction and operation of OCS wind turbines will provide insight into the actual disturbances to the environment and allow BOEM to implement effective mitigation strategies to minimize these impacts.

– Janet Purdy, Schatz Strategy Group

For More Information

Real-time Opportunity for Development Environmental Observations (RODEO)

https://www.boem.gov/Real-time-Opportunity-for-Development-Environmental-Observations/

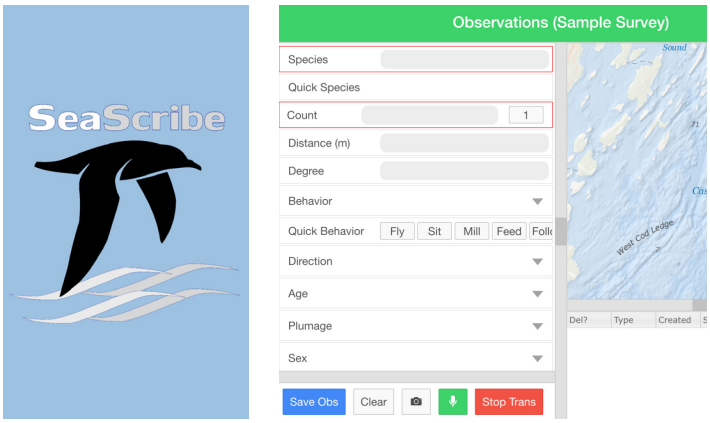
Avian Studies in the 21st Century

Development of the SeaScribe Mobile App

Offshore seabird, marine mammal, and sea turtle surveys are necessary to collect baseline and project-specific data for OCS development. BOEM has funded the development of the SeaScribe mobile app to standardize data collection. The app runs on common operating systems (e.g., iOS, Android) and most mobile devices. This app will benefit researchers, developers, and BOEM as it will allow for easier sharing and usability of the data.

SeaScribe was designed to have better data checking than existing processes, improve data standardization across surveys, improve data entry, and speed up the availability of quality-controlled data. It provides an easy-to-use, intuitive application for the collection of wildlife survey data including geo-referenced effort and observation data. This application also captures environmental conditions and behavioral information.

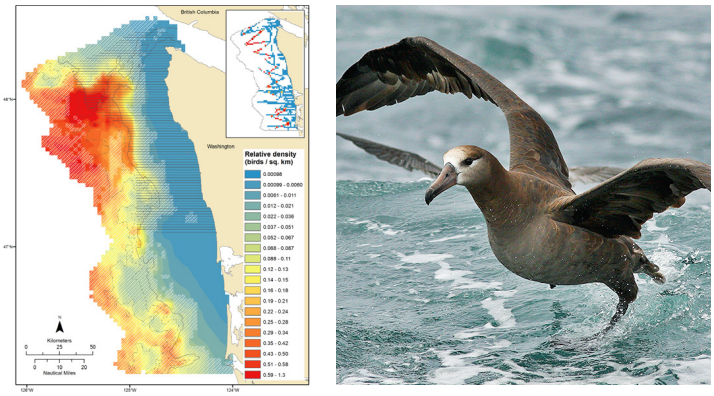
This application is freely available to regulators, developers, and the public alike. BOEM is confident this app will greatly improve data standardization and work flow, reduce data entry errors, and decrease the time from raw data output to finalized dataset for analysis.



SeaScribe logo and mobile preview graphic of a sample survey.

Data Synthesis and Predictive Modeling of Marine Bird Spatial Distributions

Seabird distribution is a basic informational need to assess impacts of OCS development on marine birds. Despite the existence of extensive seabird databases that provide relative density estimates and distribution, there are logistical challenges associated with sampling in the marine environment that have left many gaps in our knowledge. For example, species-specific estimates of distribution, relative abundance, and occurrence probability can be improved and extended to areas between transects or in unsurveyed areas by incorporating appropriate environmental and oceanographic predictive variables to model continuous density distributions of marine birds.



Left: Relative density map of Black-footed albatross off the Washington coast. *NOAA*. Right: Black-footed albatross. *Photo by David Pereksta, BOEM*.

Sampling the marine environment is difficult due to weather and other logistics; therefore, approaches such as predictive population modeling are being used by BOEM and NOAA to produce high-resolution maps. These maps of predicted long-term average patterns of seabird occurrence and abundance will provide critical information to BOEM's leasing decisions for renewable energy siting and will enable BOEM to better evaluate potential environmental impacts of development.

BOEM's study "Data Synthesis and High-resolution Predictive Modeling of Marine Bird Spatial Distributions on the Pacific OCS" is identifying, collecting, and synthesizing quantitative scientific seabird survey data by performing extensive research of historical data and extracting information on sightings to identify species and groups of interest, combine species into functional groups where necessary, develop standardized effort metrics of occurrence and abundance, and develop uncertainty estimates of modeled predictions for datasets and specific bird species. A similar study was conducted along the Atlantic Coast and maps are now available through regional ocean data portals.

The study will enhance BOEM's understanding of marine bird distribution on the Pacific OCS through predictively modeling marine bird distribution, taking into account all available data and relationships with environmental variables, and mapping the predictive distribution to identify areas of persistent aggregation and avoidance.

– Janet Purdy, Schatz Strategy Group

For More Information

SeaScribe

http://www.briloon.org/seascribe

Data Synthesis and High-resolution Predictive Modeling of Marine Bird Spatial Distributions on the Pacific OCS

https://marinecadastre.gov/espis/#/search/study/100120

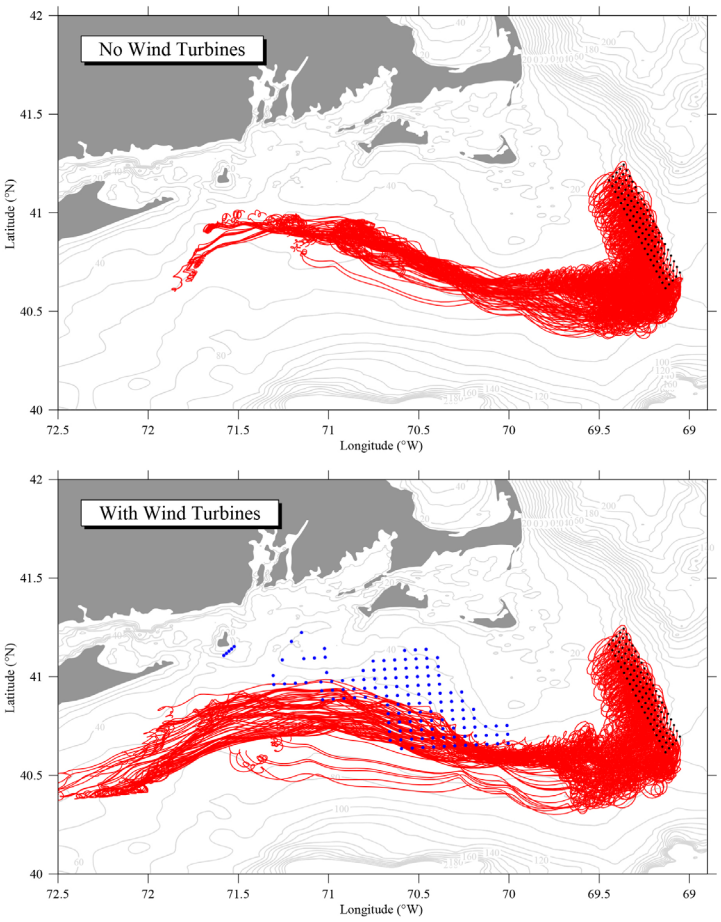
Ocean Modeling and Renewable Energy Siting

Hydrodynamic Modeling for Offshore Wind Facility Planning

In response to concerns raised by stakeholders regarding hydrodynamic changes that could be caused by the installation of OCS wind foundations, BOEM partnered with the University of Massachusetts-Dartmouth's Marine Ecosystem Dynamics Modeling Laboratory to develop an ocean modeling study. The "Use of Finite-Volume Modeling and the Northeast Coastal Ocean Forecast System in Offshore Wind Energy Resource Planning" study conducted modeling experiments to assess possible impacts on small-scale coastal and regional physical environmental processes by: 1) evaluating potential changes in ocean circulation patterns throughout the water column, and 2) determining what geographic areas and depths may be most affected by wind turbine installation and their influences on biological processes (e.g., larval transport).

The study evaluated the potential changes in ocean circulation patterns during storm events and showed that the presence of foundations could result in higher wave heights and bottom stress within the wind facility.

The study also evaluated turbine influences on biological processes such as larval transport. This objective addressed concerns raised by fishermen that altered circulation patterns could result in fish larvae, including scallop, not settling in areas where they would grow to maturity, which could affect their sustainable harvest. The results show that wind turbines in proposed OCS wind energy development areas will not have a significant influence on the southward larval transport from Georges Bank and Nantucket Shoals to the Mid-Atlantic Bight during storm events, although relatively large cross-shelf larval dispersion could develop as a result of wind turbine placement.



Model-predicted trajectories of particles for the cases without (upper) and with (lower) wind turbines. A total of 100 particles (black dots) were released with separate scales of 1.4 km in the east-west direction and 3.2 km in the south-north direction over the western slope offshore New England.

"Bayesian Analysis for Spatial Siting (BASS) Project"

Another BOEM study that addressed siting issues of coastal and marine spatial planning integrated oceanographic, ecological, and human use data; stakeholder input; and cumulative impacts to evaluate ocean renewable energy siting proposals. The BASS tool is effective at combining objective scientific data with subjective information based on human perspectives and values. Included in the approach is the understanding of the ocean-scape, the ecological functions, and the value to the community or stakeholder.

To date, nearly all spatial planning and analysis tools use Geographic Information Systems (GIS) applications that are limited in the ability to handle uncertainties in environmental changes over time. Therefore, the information presently available for ocean renewable energy project siting in the context of coastal and marine spatial planning is often uncertain, incomplete, and evolving. BASS is capable of integrating the biological, social, and economic data for assisting with the evaluation of proposed project sites in data-poor or data-deficient situations.

The BASS tool utilizes Bayesian decision methods to account for uncertainty and manages multiple data types, including stakeholder preferences and GIS-based data processing.

– Janet Purdy, Schatz Strategy Group

For More Information

Use of Finite-Volume Modeling and the Northeast Coastal Ocean Forecast System in Offshore Wind Energy Resource Planning

https://www.boem.gov/NE-Ocean-Forecast-Model-Final-Report/

Bayesian Analysis for Spatial Siting (BASS) Project

https://marinecadastre.gov/espis/#/search/study/23166

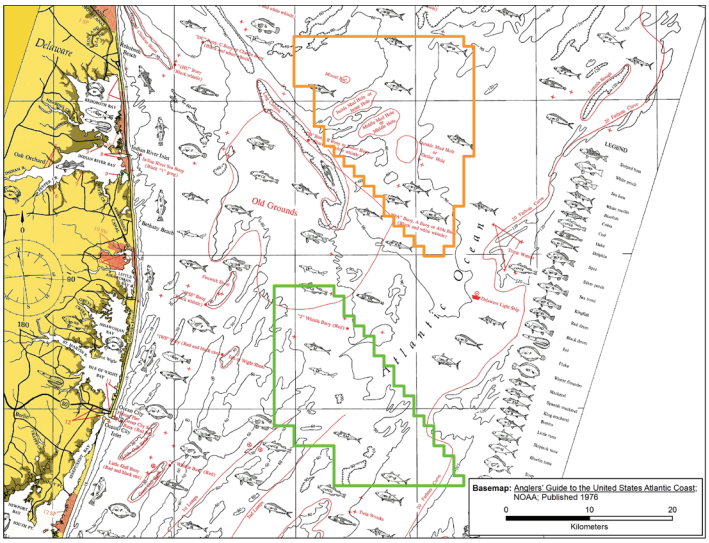
Studying the Socioeconomic Impacts of OCS Development

Commercial Fishing along the Atlantic Coast

Commercial and recreational fisheries play a significant part in the U.S. economy and food supply. The purpose of the study "Socio-Economic Impact of OCS Wind Development on Fishing" is to measure and analyze the potential impacts to fisheries from siting OCS wind turbines in the Atlantic region.

BOEM's Atlantic renewable energy planning areas extend from Massachusetts to South Carolina; the diversity of fish resources and the manner of fishing varies in this region. The report identified areas where the greatest value of fish is harvested and identified the ports and fishery sectors (e.g., gear, species) that support that activity. Fishing along the Atlantic seaboard supports direct and indirect food sales and industrial processing, and provides valuable recreational experiences. BOEM believes that with proper planning and mitigation, these activities can co-exist with renewable energy development. The final report is expected to be published in March 2017 and the raster data is available at: www.boem.gov/Renewable-Energy-GIS-Data.

Challenges for OCS development in this region include minimizing space-use conflicts, estimating the effects on artificial reefs, avoiding habitat alteration, addressing noise reduction from construction, and considering the effect of any electromagnetic fields.



BOEM evaluated historic fishing data such as the digitized "Angler's Guide" (above) and through recent studies.

Understanding Spatially-Explicit Social Values

Social values can often supersede general support for renewable energy development and can pose a major challenge to siting projects. BOEM's mission is to promote environmentally responsible energy development. This effort includes understanding the human values placed on development sites. Identifying and understanding these values, and their relationship to social action, will help BOEM plan for stakeholder response and to appropriately mitigate impacts.

Baseline information on human uses of the marine environment is increasingly available from both BOEM studies and outside surveys. However, many studies and surveys focus on a limited range of stakeholder groups and rely heavily on subjective assessments of the value of contested marine spaces. Members of smaller, under-represented stakeholder groups have not always been engaged in the collection of use or value data.

For BOEM to objectively understand stakeholders' place-based values and scientifically analyze how to address their concerns, we must proactively ask the right questions: Where are the areas that are most important? Why are they the most important? How can we work together to prevent and mitigate impacts? Gaining this understanding and giving a voice to all stakeholders—not just the loudest, but also the under-represented—is essential to responsible decision-making.

This ongoing study is collecting spatially-explicit use and value data relevant to OCS development areas planned specifically in the North and South Carolina Wind Energy Areas. The study's objectives are to document place-based values, identify statistically-significant relationships between social and environmental attributes, develop models to assess the probabilities of social action, and highlight potential conflicts related to project siting.

Offshore Floating Wind (OFW) and Marine Hydrokinetic Facilities (MHK)

The Pacific Coast is characterized by rapidly increasing water depths that exceed the feasible limits of fixed-bottom platforms on the OCS, making OFW technology more appropriate since the foundation is floating and moored to the seafloor, rather than pile-driven into it.

The study "Determining the Infrastructure Needs to Support Offshore Floating Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii" assessed current port facilities' capabilities and projected infrastructure changes that may be required to support the OFW and MHK industries for Pacific harbors and ports. Information obtained from this study will aid in BOEM's environmental reviews, evaluations, and development of mitigation measures designed to ensure environmentally safe and sound operations from OCS renewable energy activities.

Results of the study demonstrate that the port network on the Pacific West Coast and in Hawaii appears capable of

supporting the present scale of the offshore renewable energy industry without significant land redevelopment or construction of purpose-built marine terminals. Additionally, the Pacific West Coast has adequate marine vessel technologies available relative to the existing industries in those areas.

Primary Findings

- Vessels - Exact vessel fleet for installation work will depend on developer technology, vessel availability, economics, timeline requirements, location, proximity to port, and metocean conditions.
- Infrastructure - Facilities may require 10–50 acres or more, depending on the type and number of components being fabricated; a single fabrication facility may require 1,000 skilled workers.
- Ports – Bearing capacity of dockside areas is critical for the offloading and loading of components and ground investigations, and dockside strengthening may be required at some locations for component laydown and crane considerations.

Offshore Floating Wind Economic Impacts

To better understand the economic impacts of large-scale deployment of OFW technology, BOEM commissioned the National Renewable Energy Laboratory (NREL) to analyze potential employment and economic impacts of OFW deployment in Hawaii, Oregon, and California. Gross economic impacts presented in the study "Floating Offshore Wind and Potential for Jobs and Economic Impacts in Hawaii, Oregon, and California" were generated using NREL's Offshore Wind Jobs and Economic Development Impact (JEDI) model. JEDI models are commonly used to estimate gross economic impacts from the development and operations and maintenance (O&M) of energy projects.

Results highlighted in these reports show that offshore wind could contribute to economic development both now and in the future. For example, NREL estimated that a single 400-megawatt OFW project in Hawaii would support 1,660 full-time equivalent (FTE) construction jobs and 190 ongoing O&M FTE jobs. In California, NREL estimated that 10,000 megawatts of OFW development by 2050 would have an added value of $2.4 billion to the state's Gross Domestic Product. Local sourcing of materials and labor would greatly increase the gross economic impact of offshore wind energy deployment.

The JEDI analyses can be used to better understand the general scale of economic opportunities that could result from offshore wind development. While the reports discuss hypothetical offshore wind development scenarios, NREL has made its JEDI Offshore Wind Model available to enable specific project inputs and generate project-specific results.

– Janet Purdy, Schatz Strategy Group

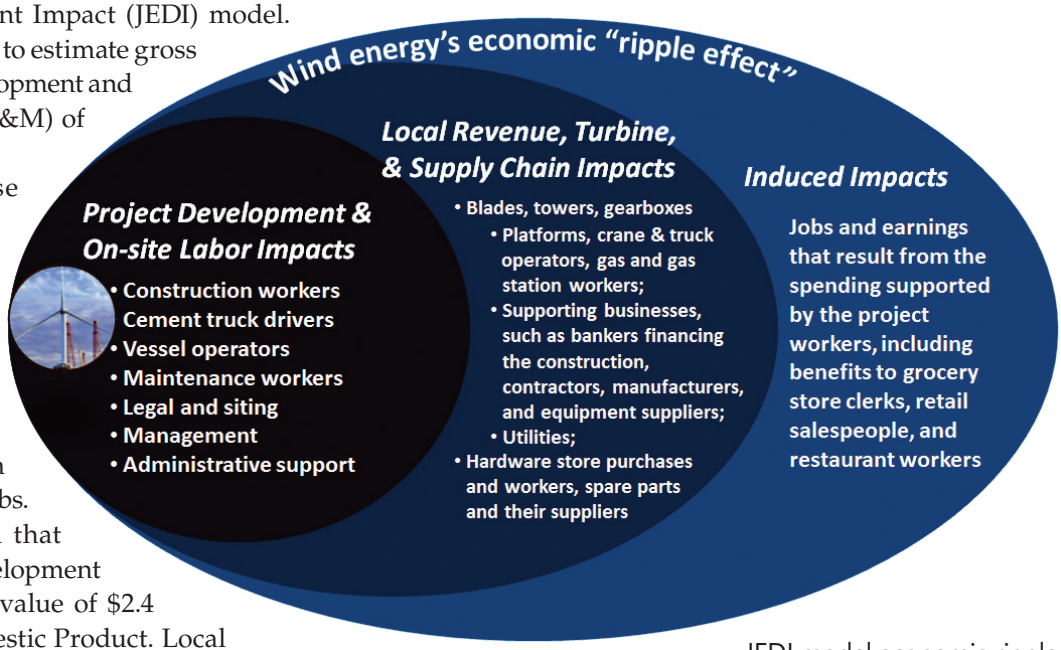
For More Information

Socio-Economic Impact of OCS Wind Development on Fishing
https://marinecadastre.gov/espis/#/search/study/100058

Understanding Spatially Explicit Social Values
http://www.boem.gov/Quantitative-Assessment-of-Spatially-Explicit-Social-Values/

Determining the Infrastructure Needs to Support Offshore Floating Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii
https://marinecadastre.gov/espis/#/search/study/100089

Floating Offshore Wind and Potential for Jobs and Economic Impacts in Hawaii, Oregon, and California
(Hawaii) http://www.boem.gov/2016-032/
(Oregon Coastal Counties) http://www.boem.gov/2016-031/
(Oregon) http://www.boem.gov/2016-030/
(California) http://www.boem.gov/2016-029/



JEDI model economic ripple effect: sample jobs in OCS wind.
Source: *National Renewable Energy Laboratory.*

Atlantic Ocean Energy and Mineral Science Forum

BOEM hosted the Atlantic Ocean Energy and Mineral Science Forum in Sterling, Virginia on November 16 and 17, 2016. The forum showcased the ongoing and recently completed studies along the Atlantic Outer Continental Shelf that BOEM is funding to support the Renewable Energy, Marine Minerals, and Conventional Energy Programs. The forum objectives were to: 1) share with the public information from BOEM's and other recently completed studies and ongoing science activities in the Atlantic region; 2) identify research needs and information gaps for the development of new studies through BOEM's Environmental Studies Program; and 3) provide the public an opportunity to learn how BOEM utilizes the best available scientific information to support our decision-making processes.

The topic areas presented included social science and cultural resources, marine mammals, environmental stressors, coastal and marine birds, fish acoustics, and marine minerals-related science. For the final session, the attendees were separated into four groups and asked to provide input for future studies along the Atlantic coast.

Highlights from the forum included presentations about the extent of passive acoustic monitoring that is occurring along the entire coast from shallow water to the continental shelf break. These measurements will provide new information about the occurrence and movements of marine mammals as they pass through the area. BOEM is actively collecting information about how the public views offshore renewable energy through various survey techniques. The Real-time Opportunity for Development Environmental Observations (RODEO) program presented results from monitoring construction of the Block Island Wind Farm including acoustic measurements and seafloor disturbance.

On the second day, the audience heard about the latest in survey and mapping efforts for marine and coastal birds. For the first time, relative distribution and abundance maps are available for forty species of marine birds throughout the entire Atlantic region. BOEM is planning to study how fish respond to sound and experts were brought together to share current knowledge about fish and acoustics and to help guide future studies in this topic area. The Marine Minerals Program is supporting an extensive ecosystem study of shoals near Cape Canaveral to help evaluate the environmental consequences of removing sand from this environment.

At the end of the second day, participants offered a broad range of suggestions for future work. A summary of the forum and all of the presentations will be posted to BOEM's website in early 2017.

– Mary Boatman, BOEM

Rodney Cluck, Chief of BOEM's Environmental Studies Program, addresses the audience at the Atlantic Ocean Energy and Mineral Science Forum held in Sterling, Virginia in November. *Photo by Marjorie Weisskohl, BOEM*

Panelists discuss BOEM's Marine Minerals Program at the Atlantic Ocean Energy and Mineral Science Forum. *Photo by Marjorie Weisskohl, BOEM*

A breakout group discusses specific topics of scientific interest at the Atlantic Ocean Energy and Mineral Science Forum. *Photo by Marjorie Weisskohl, BOEM*

Benthic Habitats and Renewable Energy Structures as Fish-Attracting Devices

With the offshore Pacific Northwest possessing great potential for both marine hydrokinetic and floating wind renewable energy technologies, BOEM sought to assess the potential effects of development on benthic organisms and how they relate to the physical environment. By assembling this information for the first time in this region, the study "Benthic Habitat Characterization Offshore the Pacific Northwest" provides predictive capabilities of where benthic habitats and invertebrate species or communities of interest may occur to inform decision-makers regarding siting of facilities. The objective of the study was to provide an understanding of the regional physical properties of the seafloor and the distribution and location of invertebrates.

The approach to narrowing the information gap produced measurable gains in baseline data. Accomplishments included developing and updating several seabed and sub-bottom classification maps that extend from northern California to the Canadian border. The mapping components provided important updates for the regional knowledge base, estimating a 7% increase in mapping coverage. Thirteen new local seabed habitat maps were created and 37 new, externally developed sources of mapping data were consolidated. Three remotely operated vehicle surveys found distinct communities of invertebrate species associated with rocky outcrops. Invertebrate communities living in soft sediments were distinct across small changes in depth and percentages of sand. Novel habitat suitability models successfully predicted the occurrence of specific species across the Pacific Northwest.

In the future, before decisions about renewable energy installations can be made, BOEM will need to know what resources might be impacted. While biological communities are shaped by a variety of bottom-up, top-down, and species interaction factors, the substrate type is a major driver of the structure of mega-invertebrate communities. Thus, more precise habitat mapping is necessary to understand their distributions.

The study "Evaluating the Potential for Marine and Hydrokinetic Devices to Act as Artificial Reefs or Fish Aggregating Devices" was conducted to address the growing demand for data regarding the potential ecological effects of marine renewable energy devices such as wave energy converters (WEC) and tidal energy converters (TEC) off the Pacific Coast and Hawaiian coast waters. Specifically of interest is the potential for these structures to function as artificial reefs or fish aggregating devices (FADs). Information from previous studies, resource managers, and subject matter experts was assessed and the evaluation was based on an analysis of surrogate structures located in tropical, subtropical, and temperate coastal waters.

Vermilion rockfish at Platform Grace. *Photo by Donna Schroeder, BOEM.*

Surrogate structures reviewed included bottom-oriented structures (natural reefs, artificial reefs, and marine debris), combined bottom and midwater/surface-oriented structures (oil and gas platforms, kelp beds/rocky reefs, mariculture facilities, purpose-built FADs, piers, and marinas), and midwater/surface-oriented structures (floating drift kelp and floating debris). For each of the surrogate structures, the fish assemblages, ecological interactions, and sensitive fish species that may occur at marine and hydrokinetic devices with similar key features were described. Maps were created to show the locations of each surrogate structure to identify the general areas covered by this study.

Results indicated there are limitations to using surrogate structures to evaluate potential fish interactions with commercial installations of WECs or TECs. A study of existing buoys/moorings may increase understanding of potential fish interactions with individual or small numbers of WEC devices; however, scaling up to larger arrays would require evaluating fish interactions after installation of a commercial-scale development. In addition, potential fish interactions as a result of indirect effects, such as from electromagnetic fields or sound emitted by WECs or TECs, could only be evaluated after devices are deployed and operational.

– Janet Purdy, Schatz Strategy Group

For More Information

Benthic Habitat Characterization Offshore the Pacific Northwest
https://marinecadastre.gov/espis/#/search/study/27103

Evaluating the Potential for Marine and Hydrokinetic Devices to Act as Artificial Reefs or Fish Aggregating Devices
http://www.boem.gov/2015-021/

BOEM's Completed Studies in the Pacific Region
http://www.boem.gov/Pacific-Completed-Studies/

Spotlight on A Scientist: Brian Hooker

What is your job at BOEM?

I am a biologist within the Environment Branch for Renewable Energy in Sterling, Virginia. My day-to-day job revolves around reviewing lessee plans in support of Atlantic OCS renewable energy, reviewing and writing environmental assessments under the National Environmental Policy Act, the Magnuson-Steven Fishery Conservation and Management Act, and the Endangered Species Act. I also spend a third of my time developing and managing environmental studies in support of the Program, and conducting outreach with fisheries managers and fishermen themselves regarding BOEM's environmental assessments and environmental studies.

Why did you decide to work for BOEM?

I was always interested in natural resource management even before I knew what to call it. Growing up near the mouth of the Chesapeake Bay, the marine environment and all it provided was the natural resource that interested me the most. After working in fisheries management for 7 years, BOEM offered me an opportunity to work across a wide range of marine resources while learning about the exciting offshore wind energy industry that is growing along the Atlantic coast. One of the things that drew me to BOEM was the opportunity to work on a wide array of topics ranging from renewable energy technology to interaction of the technology with marine resources that may occur in leased areas. At the time I was hired in 2009, I was the sole "marine" biologist subject matter expert in the Renewable Energy Program.

Brian Hooker, Biologist from the Environment Branch for Renewable Energy in Sterling, Virginia

What role do you play in BOEM's Environmental Studies Program?

I contribute to BOEM's Environmental Studies Program (ESP) by developing and reviewing study ideas that come from external partners and from our own internal subject matter expert teams. BOEM is often "in the field" listening to constituents through input on environmental assessments or as part of general planning and outreach. This feedback is then brought to bear in the drafting of our section of BOEM's annual Studies Development Plan. We all then have to develop, execute, and monitor the work funded by the ESP. The success of those projects is important as it feeds right back into future environmental assessments.

How has your educational background and experience prepared you for the work you do?

Although growing up on the Chesapeake Bay taught me a lot about the marine life and livelihoods it supported, it wasn't until I studied environmental science at Lynchburg College in Virginia and became a practitioner of natural resource management in the Peace Corps in West Africa that I more fully appreciated what was truly involved in the field and what skills I needed to further develop. My Peace Corps experience allowed me to look for a graduate school program to strengthen the skills I needed when I returned to the U.S. The program that matched what I was looking for was Duke University's Nicholas School of the Environment. I don't think I would have gotten to work for the National Marine Fisheries Service or BOEM without that educational and practical experience. I still use my personal connections and experiences from the National Marine Fisheries Service on a weekly—if not daily—basis.

What do you find most rewarding about your work?

There are a couple of things I find rewarding in my work. One is the opportunity to work with a great group of talented staff at BOEM, truly engaged external constituents, and active Federal partners. The second, which I've already mentioned, is the ability work in many different dimensions of OCS renewable energy development. I know from previous work that biologists are often assigned very specific areas of expertise, so I find it rewarding to work with such a wide variety of projects across a diverse environment that makes up the Atlantic Outer Continental Shelf.

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New Waves

Late-Breaking News & Information

National Ocean Council Approves Regional Ocean Plans

The National Ocean Council (NOC) has certified two regional Ocean Plans that the Department of the Interior (DOI) has long been developing with multiple partners. Starting in 2013, the Mid-Atlantic Regional Planning Body (RPB) designed and carried out a regional ocean planning process in collaboration with the public, stakeholders, and partners including the Mid-Atlantic Regional Council on the Ocean and the Mid-Atlantic Ocean Data Portal Team. The main product of this effort is the Mid-Atlantic Regional Ocean Action Plan, which will improve coordination and information sharing as we work together to better manage the region's ocean ecosystems and resources.

The RPB shared the Draft Plan for public review in July 2016 and revised the Plan after considering all input received during the 60-day public comment period. The RPB submitted the final Plan to the NOC for certification in early November 2016. The Plan and related materials are available on: http://www.boem.gov/Ocean-Action-Plan/.

The Mid-Atlantic RPB built upon the efforts of the Northeast RPB, which was established in 2012 and submitted the Northeast Ocean Plan to the NOC for certification in October 2016. The Plan was developed following several years of public engagement, scientific study and data analysis, and collaboration—along with significant feedback from the general public and stakeholders interested in the future of New England's ocean and its resources. For information about the Plan, including a response to comments document, go to: http://www.neoceanplanning.org/plan/.

The RPBs have begun implementation of the Plans and will continue the regional planning process by bringing together federal, state, tribal, and fishery management partners to enhance communication, improve coordination, and enable agencies to make more informed and transparent decisions about our ocean resources.

- Bob LaBelle, Senior Advisor to the Director, BOEM; Mid-Atlantic Regional Planning Body Federal Co-Lead