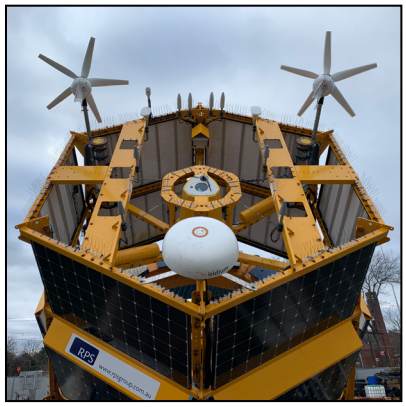
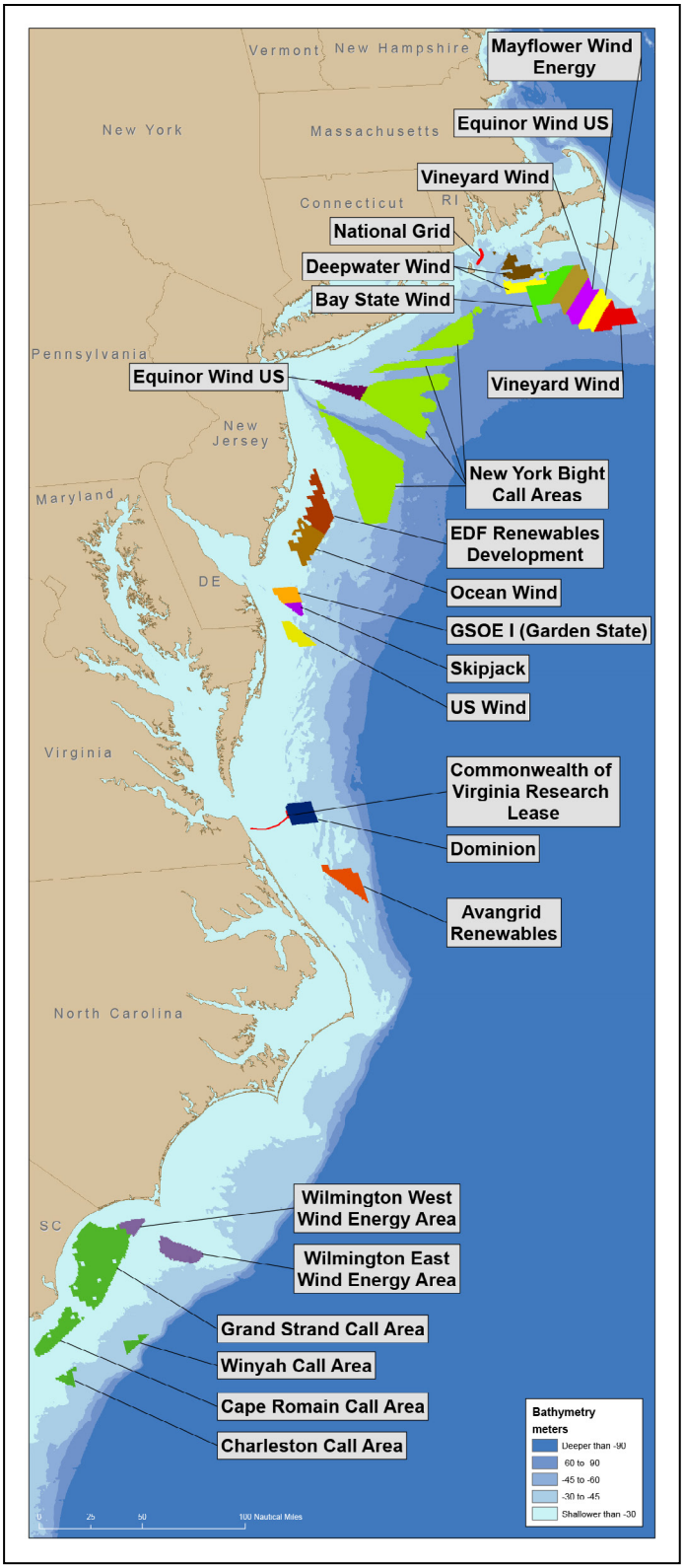
BOEM
Bureau of Ocean Energy Management

Office of Renewable Energy Programs



2018
Atlantic Science Year in Review

U.S. Department of the Interior | Bureau of Ocean Energy Management



Overview

The Bureau of Ocean Energy Management (BOEM) funds environmental studies for information needed to predict, assess, and manage impacts from offshore energy and marine mineral activities on human, marine, and coastal environments as mandated under Section 20 of the Outer Continental Shelf Lands Act.

This year in review presents the studies completed in 2018 specifically in support of BOEM's Offshore Renewable Energy Program along the Atlantic Coast. The studies represent a broad spectrum of research and monitoring to address a variety of environmental concerns and issues. This review represents a snapshot of the ongoing and completed studies funded in whole or in part by BOEM.

To learn more about other studies, please visit the BOEM website at **www.boem.gov**.

At left: *BOEM's renewable energy lease and planning areas in federal waters on the Outer Continental Shelf*

Table of Contents

Inter-disciplinary Study of the Possible Link Between Space Weather, Geomagnetic Storms and Cetacean Mass Strandings

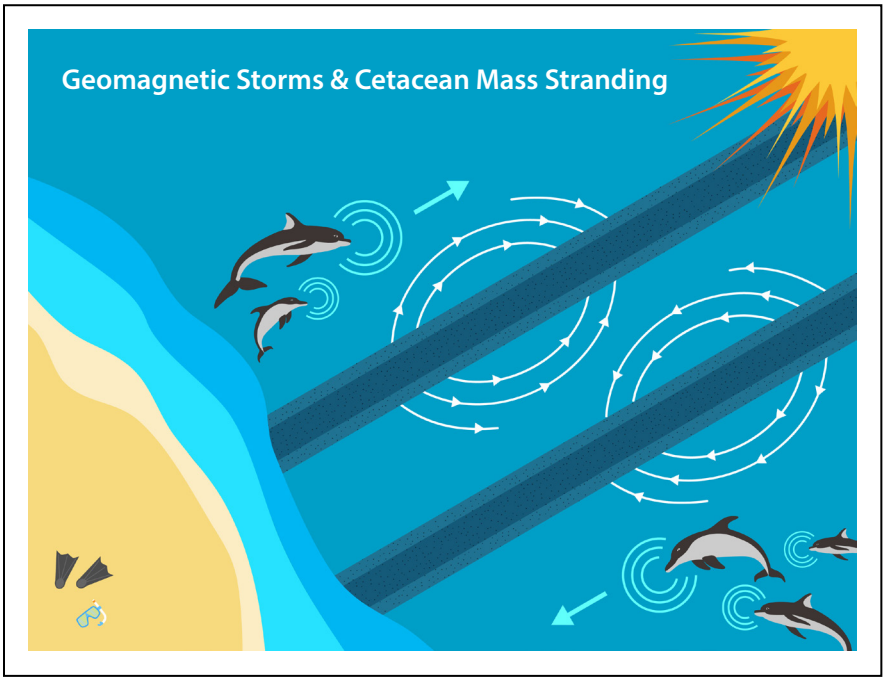
Conducted by: National Aeronautics and Space Administration (NASA) Goddard Space Flight Center

Key Researchers: A. Pulkkinen, K. Moore, R. Zellar, O. Uritskaya, E. Karakoylu, V. Uritsky, D. Reeb

Funded by: Bureau of Ocean Energy Management (BOEM), NASA, and International Fund for Animal Welfare

Cetacean mass strandings, where numbers of otherwise healthy animals beach for no apparent reason, are one of the great mysteries in marine biology. Some causes considered are natural, including atmospheric weather or oceanic conditions like storms, while other potential causes may be by humans, such as from seismic surveys.

One theory is that marine mammals are responding to geomagnetic anomalies. This study explores the correlation between mass strandings and geomagnetic storms to determine if this could be an explanation.



A correlation between strandings and geomagnetic storms was not detected, although the data set is small.

Findings

- A correlation between strandings and geomagnetic storms was not detected, although the data set is small.
- Other environmental factors may account for some strandings.
- Improved data sharing and data practices are needed to assist with determining the causes of mass strandings.

How BOEM will use this information

- Use the data to look at other causes of mass strandings, including other natural events
- Improve our analysis of mass strandings and correlations with human activities

Additional information

Final report: marinecadastre.gov/espis/#/search/study/100145

Video: svs.gsfc.nasa.gov/12700

Tracking Movements of Threatened Migratory Rufa Red Knots in U.S. Atlantic Outer Continental Shelf Waters

Conducted by: U.S. Fish and Wildlife Service

Key Researchers: P. Loring, J. McLaren, P. Smith, L. Niles, S. Koch, H. Goyert, H. Bai

Funded by: Bureau of Ocean Energy Management (BOEM)

Information on the movements and flight altitudes of high-priority avian species is essential for estimating exposure to collision risks in offshore wind energy areas and developing strategies to mitigate risks. In this study, digital very-high frequency transmitters and an array of automated radio telemetry stations were used to track the movements of the *rufa* red knot, a shorebird that is a threatened species under the Endangered Species Act. The study area encompasses a portion of the Atlantic Outer Continental Shelf extending from Cape Cod, Massachusetts, to Back Bay, Virginia.

Findings

- Of the 388 tagged birds, 8% were detected passing through one or more Wind Energy Areas (WEAs) during fall migration.
- Most birds departed on migration prior to dusk under clear skies with little to no precipitation.
- Three-quarters of the flights across WEAs were within the rotor swept zone (20 to 200 m above the sea surface) of future wind turbines; however, the error around the estimated flight heights was very large (typically 100 to 200 m).

How BOEM will use this information

- Inform environmental reviews and Endangered Species Act consultations related to the development of wind energy resources
- Determine risk of offshore wind development to migrating red knots

Additional information

Final report: marinecadastre.gov/espis/#/search/study/100111

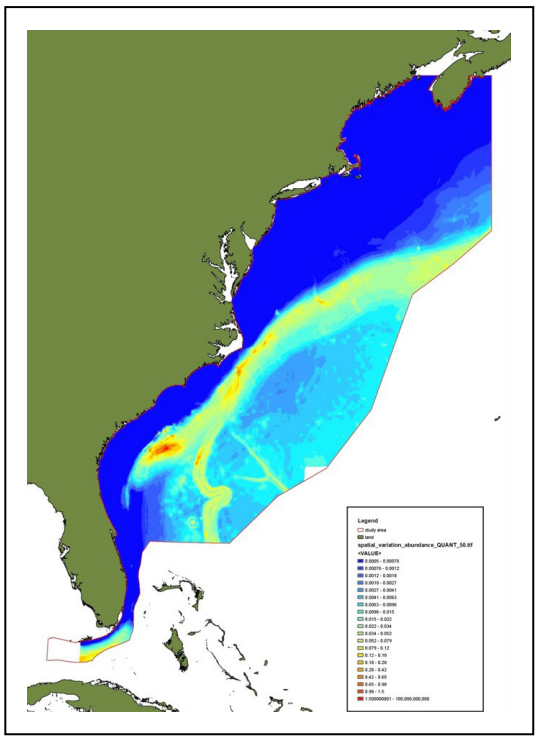
From top: Pam Loring holding a tagged common tern, nano tag on a common term, common tern in flight with nanotag.

Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning

Conducted by: National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science

Key Researchers: A. Winship, B. Kinlan, T. White, J. Leirness, J. Christensen

Funded by: Bureau of Ocean Energy Management (BOEM)



From top: Relative distribution of Black-capped Petrels with yellow to orange areas indicating higher density, Black-capped Petrel in flight

Marine birds have the potential to be affected by human activities in the ocean environment such as offshore wind energy development. This study analyzed sighting survey data from over three decades to develop seasonal maps of the spatial distributions of 47 marine bird species in U.S. Atlantic Outer Continental Shelf and adjacent waters from Florida to Maine. The relative importance of different predictor variables, such as oceanographic conditions or bathymetry, is also presented, indicating which variables most influenced the predicted distributions for each species in each season.

Findings

- A series of seasonal maps are presented for each of the 47 marine bird species.
- The maps identify areas where the densities of marine bird species are likely to be higher or lower on a seasonal basis and do not present actual numbers of individuals.

How BOEM will use this information

- Inform planning for offshore wind development along the Atlantic Coast
- Evaluate plans from offshore wind developers to inform monitoring efforts
- Inform environmental reviews and Endangered Species Act consultations related to the development of the nation's energy resources

Additional information

Final report: marinecadastre.gov/espis/#/search/study/100065

Maps are available here: www.boem.gov/AppendixC/

Northeast Ocean Data Portal: www.northeastoceandata.org

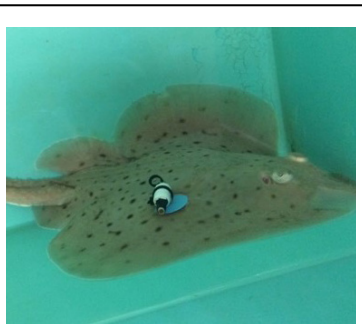
Mid-Atlantic Ocean Data Portal: portal.midatlanticocean.org

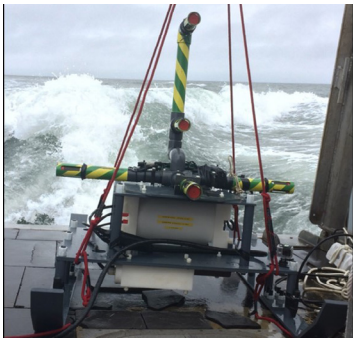
Electromagnetic Field (EMF) Impacts on Elasmobranch (Shark, Rays, and Skates) and American Lobster Movement and Migration from Direct Current Cables

Conducted by: University of Rhode Island

Key Researchers: Z. Hutchison, P. Sigray, H. He, A. Gill, J. King, C. Gibson

Funded by: Bureau of Ocean Energy Management (BOEM)





From top: Lobster with tag, skate with tag, Swedish Electromagnetic Low-noise Apparatus used to measure electric and magnetic fields from subsea cables

EMFs are produced by offshore renewable energy infrastructure, such as submerged power transmission cables, and they have the potential to cause ecological effects or impacts on marine organisms. This study investigated the effects of EMF on two model organisms: the American lobster (to see if the EMF from cables restricts their movements and migration) and the little skate, a member of the most electro-sensitive taxa, which may be attracted to the EMF from cables, altering their foraging or movement behavior. Field surveys of EMF were undertaken on three subsea power cables: two high voltage direct current (HVDC) cables and one alternating current cable. This study developed a field experiment using large netted enclosures to assess the behavioral response when exposed to the EMF from an HVDC cable. The experiment used novel 3D acoustic telemetry to quantify animal movements.

Findings

- Field-deployed animal enclosures and acoustic telemetry methods successfully allowed the collection of in situ, high frequency, three-dimensional positional data on individual animals.
- The American lobster exhibited a statistically significant but subtle change in behavioral activity when exposed to the EMF of the HVDC cable.
- The little skate exhibited a strong behavioral response to the EMF from the HVDC cable.
- EMF associated with the HVDC cable did not constitute a barrier to movements across the cable for either lobsters or skates.

How BOEM will use this information

- Evaluate future wind projects and effects of EMF from the associated cables
- Characterize the cumulative impacts from multiple wind facilities

Additional information

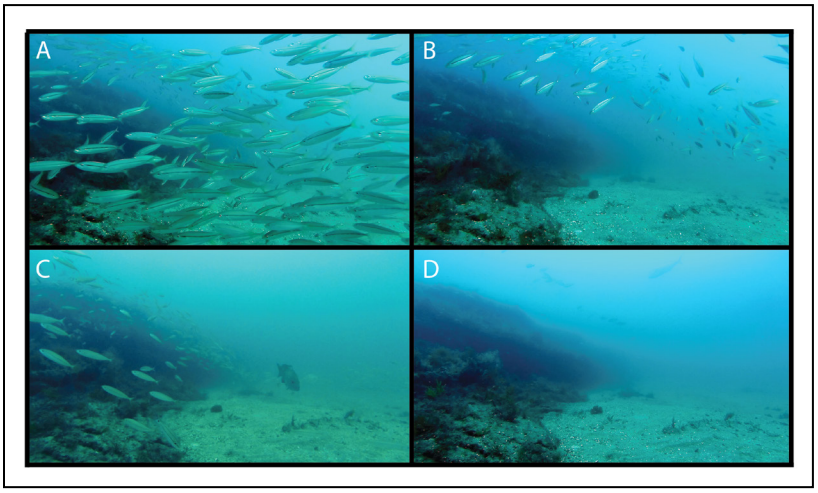
Final report: marinecadastre.gov/espis/#/search/study/100067

Documenting Fish Response to Seismic Surveying and Establishing a Baseline Soundscape for Reefs in Onslow Bay, North Carolina

Conducted by: University of North Carolina, National Oceanic and Atmospheric Administration, Duke University

Key Researchers: A. Paxton, C. Voss, C. Peterson, J. Taylor, E. Ebert, B. Degan, D. Nowacek, J. Dale, E. Cole

Funded by: Bureau of Ocean Energy Management (BOEM)



Fish observed on the reef off North Carolina

Hardbottom reefs that occur on the North Carolina Outer Continental Shelf support a diverse community of fishes and present an opportunity to test how underwater sound affects reef fish. During September 2014, four offshore temperate reefs within Onslow Bay, NC, were monitored to determine the response of reef fishes to a planned scientific seismic survey. Also, fish and soundscape monitoring stations installed in September 2015 off the coast of NC documented the marine soundscape and associated fish communities on artificial and natural reefs of the NC continental shelf over a period of ten months. The objective was to provide a baseline record of bioacoustics and anthropogenic noise in Onslow Bay, NC.

Findings

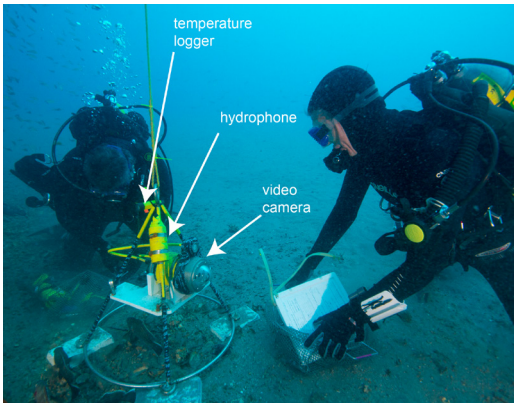
- Although working with limited data, there is evidence that during exposure to seismic noise, the prevailing pattern of heavy fish use of reefs during the evening was suppressed.
- Reducing opportunities for fish to aggregate causes concern, as this reduction could lessen options for foraging, mating, or other important life history functions.

How BOEM will use this information

- Quantitatively assess deviations from the baseline soundscape conditions that may be expected with offshore energy development
- Inform assessments of sound impacts on reef fish

Additional information

Final report: www.boem.gov/BOEM-OCS-Report-2018-051

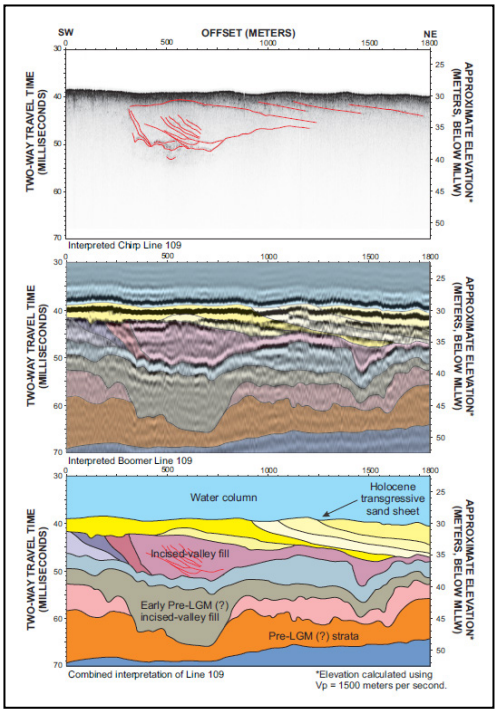


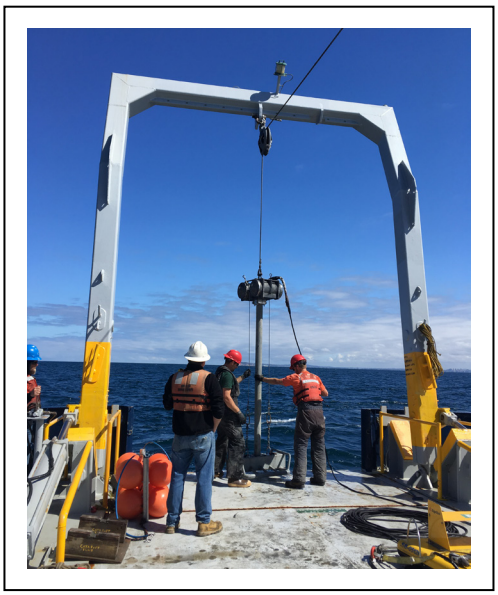
Deployment of acoustic monitor by divers

Data Gathering Process: Geotechnical Departures for Offshore Wind Energy

Conducted by: DNV GL | **Key Researchers:** DNV GL

Funded by: Bureau of Ocean Energy Management (BOEM)





BOEM assesses proposed offshore wind developments as required under 30 CFR part 585. The Construction and Operations Plan (COP) submitted by a developer details all planned facilities and activities. The COP must demonstrate that the project is being designed, constructed, and developed in a manner that conforms with BOEM's renewable energy regulations and should provide adequate information to inform BOEM's National Environmental Policy Act review and other relevant legal and regulatory requirements. This report provides guidance regarding the assessment of regulatory departure requests related to geotechnical investigations for offshore wind facilities.

Findings

- This report describes a phased approach by developers for determining a project layout that is used successfully in Europe.
- The phased approach should include the conceptual geological framework, geotechnical parameters, and evaluation of geohazards.
- The proposed methodology will inform BOEM on how to align geotechnical requirements with the Design Envelope Approach to Construction and Operations Plans.

How BOEM will use this information

- Evaluate departure requests from current regulations related to geotechnical investigations with consistency
- Inform future rulemaking regarding information requirements at different stages of the renewable energy process

Additional information

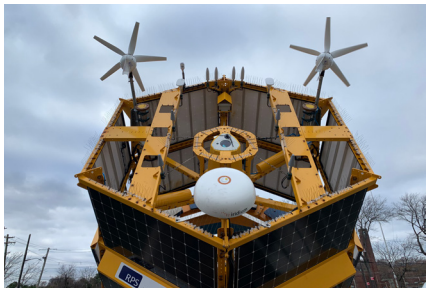
Final report: www.boem.gov/Data-Gathering-Process/

From top: Process for interpreting geophysical data, collecting a sediment core

Metocean Characterization Recommended Practices for U.S. Offshore Wind Energy

Conducted by: DNV GL | **Key Researchers:** DNV GL

Funded by: Bureau of Ocean Energy Management (BOEM)



Top and right: Meteorological buoy and instruments used for making measurements of wind and waves

Metocean (meteorological and oceanographic) data are necessary to support proper design, installation, operation, and maintenance of offshore wind facilities located within U.S. waters of the Outer Continental Shelf. This includes environmental conditions associated with movement of water, wind conditions, sea states, atmospheric parameters, and physical ocean parameters. The data supports assessments of general metocean climate for fatigue assessment, extreme conditions, and the risk of weather preventing safe access to the site and associated downtime. This study provides guidance on best practices to reliably collect, analyze, and use site-specific metocean data.

Findings

- Metocean analysis is critical for the success of the fabrication, installation, and operation of offshore wind facilities.
- The report describes detailed reporting best practices for metocean data reports, including data quality control.

How BOEM will use this information

- Provide developers with clear guidance for the collection and reporting of metocean data
- Standardize evaluations of metocean data as part of BOEM's approval process

Additional information

Final report: www.boem.gov/Metocean-Recommended-Practices

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

Conducted by: CODAR Ocean Sensors

Key Researchers: D. Trockel, I. Rodriguez-Alegre, D. Barrick, C. Whelan

Funded by: Bureau of Ocean Energy Management (BOEM)

High-frequency radar instrument used for measuring surface currents located on Block Island, Rhode Island

The U.S. currently has a national network of more than 140 coastal high frequency radars (HFR). The two-dimensional surface current data obtained from this network is invaluable for multiple applications. For example, the U.S. Coast Guard assimilates the HFR data into models to boost reliability and narrow search areas for people and vessels lost at sea.

Observations indicate that the spinning blades of offshore wind turbines cause interference in HFRs. It is therefore crucial that we understand the possible impact of these wind farms on the national radar network and that we develop techniques to mitigate the impact of turbine interference on all the radar data products.

Findings

- Wind turbine interference is caused by the amplitude modulation of the turbine's radar cross-section.
- The location of the wind turbine interference in the Doppler spectrum is predictable and can be determined from the rotation rate of the wind turbine.
- Mitigation methods that remove signals from the Doppler spectrum based on the wind turbine rotation rate estimates are effective methods of mitigating wind turbine interference.

How BOEM will use this information

- Extend the existing simulations to include interference from larger offshore wind facilities
- Develop a real-time mitigation solution

Additional information

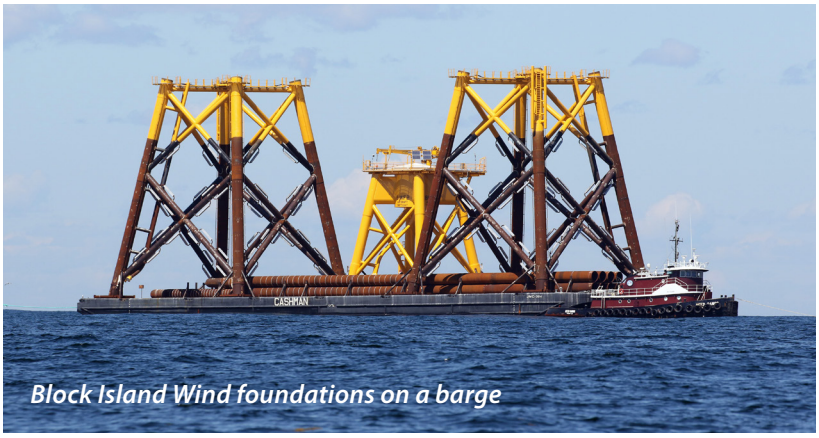
Final report: marinecadastre.gov/espis/#/search/study/100141

Field Observations During Wind Turbine Foundation Installation at the Block Island Wind Farm, Rhode Island

Conducted by: HDR

Key Researchers: J. Amaral, R. Beard, R. Barham, A. Collett, J. Elliot, A. Frankel, D. Gallien, C. Hager, A. Khan, Y-T. Lin, T. Mason, J. Miller, A. Newhall, G. Potty, K. Smith, K. Vigness-Raposa

Funded by: Bureau of Ocean Energy Management (BOEM)



Block Island Wind foundations on a barge

With the first offshore wind facilities being built along the Atlantic Coast, there is the opportunity to make direct, real-time measurements of the nature, intensity, and duration of potential stressors during the construction and initial operations of selected proposed offshore wind facilities. The first facility to be constructed is the Block Island Wind Farm (BIWF) off the coast of Rhode Island.

Monitoring was conducted at BIWF during the installation of the wind turbine foundations in the summer and fall of 2015 and includes visual monitoring of construction activities from onshore and offshore locations; onshore and offshore airborne noise monitoring; near- and far-field underwater sound monitoring; seafloor disturbance and recovery monitoring; and turbine foundation scour monitoring.

Findings

- Airborne noise monitoring data analyses indicated that the noise from the pile driving was clearly audible at the Southeast Lighthouse (3 miles away) but was not detected at Point Judith (17 miles away) on the mainland.
- Results from preliminary data analyses show that pile driving sound was above background sound levels at ranges beyond 20 km (12.4 miles).
- Seafloor disturbance from anchoring and lift boat legs recovers observably within months.
- Testing of scour monitors provided a long-term time series (16 months) of seabed elevations near the foundation that showed minor scour around the observed legs.

How BOEM will use this information

- Provide information for BOEM's evaluation of environmental effects of future facilities
- Provide data to improve the accuracy of models and analysis criteria to establish mitigation and monitoring requirements

Additional information

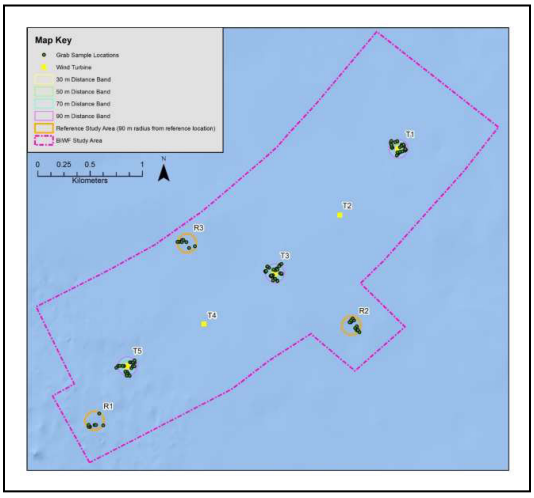
Final report: marinecadastre.gov/espis/#/search/study/100084

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island

Conducted by: HDR

Key Researchers: M. Bartley, P. English, J. King, A. Khan

Funded by: Bureau of Ocean Energy Management (BOEM)



From left: Mussels on the turbine leg at Block Island Wind Farm, sample locations around turbines and reference sites at Block Island Wind Farm

The placement of structures that have hard surfaces provides an environment for marine life to attach and flourish. The growth on the structure, in turn, provides a source of organic matter to the seafloor, which nourishes marine life on and in the seabed. This study assessed the nature and potential spatial and temporal scales of alterations in benthic macrofaunal communities because of the long-term placement of the turbine foundations. Key community characteristics evaluated included species abundance, richness, and assemblage structure, along with relationship dynamics between macrofaunal communities and their associated environments. Three turbine locations were selected for sampling based on their representativeness of the biotopes present in the study area.

Findings

- There are no substantial differences in benthic communities between turbine areas.
- There are no significant differences in benthic communities or total organic carbon levels close to turbine foundations compared to those further away.
- Only one year is represented in this study, but this forms a baseline established for future evaluation.

How BOEM will use this information

- Evaluate environmental effects of future wind facilities
- Provide useful information on biofouling of jacket type foundations, which are generally unrepresented in European studies

Additional information

Final report: www.boem.gov/BOEM-2018-047

Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism

Conducted by: University of Delaware | **Key Researchers:** G. Parsons, J. Firestone

Funded by: Bureau of Ocean Energy Management (BOEM)

Block Island Wind Farm during construction

As policy-makers consider more offshore wind energy projects, an issue that may arise is the potential conflict with recreational beach use. This is especially true on the East Coast, where millions of Americans visit the beaches annually for recreation and enjoyment. At the same time, offshore wind power projects themselves may attract beachgoers and have a positive effect on recreation and enjoyment. This report presents the results of a stated-preference survey that included 1,725 beachgoers in a sample designed to be representative of the beachgoing population on the East Coast.

Findings

- The dominant reason reported for why an offshore wind power project would have made a beach experience worse was the visual disruption of the seascape.
- A model predicting trip loss as a function of beach characteristics showed that the loss was lowest on more developed and more natural beaches and highest on beaches with intermediate development.
- The stated preference survey suggests that an offshore wind project would affect many beachgoers' experience/enjoyment on beach trips, change trip behavior, and generate curiosity trips.
- At the distances of most BOEM wind energy areas, the negatives are largely washed out by trip gain and curiosity trips, which, in many instances result in a net positive gain.

How BOEM will use this information

- Incorporate in assessments of the impacts of offshore wind energy development on recreation and tourism
- Inform the design of future evaluations of coastal community concerns

Additional information

Final report: marinecadastre.gov/espis/#/search/study/100061

Atlantic Offshore Renewable Energy Development and Fisheries: Proceedings of a Workshop

Conducted by: National Academy of Sciences, Engineering, and Medicine

Steering Committee: B. McKay, R. Beal, E. Bochenek, A. Gill, A. Grilli, E. Hoffman, W. Hogarth, P. Neubert, T. Noji, K. Stokesbury, J. Williamson

Funded by: Bureau of Ocean Energy Management (BOEM)

In support of its mission to conduct its activities in an environmentally and economically responsible way, BOEM engaged a steering committee of the National Academies of Sciences, Engineering, and Medicine to facilitate a workshop about the research and monitoring needed to assess potential impacts on fisheries from offshore wind turbine installation and operation on the Atlantic Outer Continental Shelf. This workshop was held on November 8–9, 2017, in New Bedford, Massachusetts.

The steering committee focused on southern New England, where several offshore wind leases are progressing toward construction. Representatives from research institutions, the fishing and wind industries, and state and Federal governments were invited to share their perspectives and experiences to help inform and advance guidelines for monitoring impacts on fisheries from offshore wind projects.

Concluding remarks

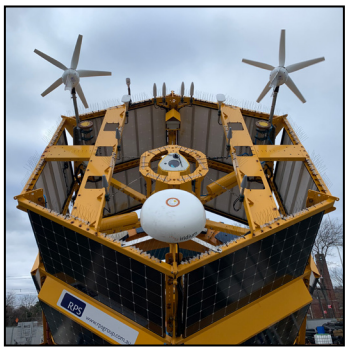
- Some attendees raised the importance of using monitoring programs to ultimately inform decision making.
- The question of what the impacts to fisheries will be is partly a biological one, but also a management question dependent on how future wind farms are sited and potential fisheries access rule.
- Several audience members supported the development of regionally focused advisory groups that can provide coordinated input.
- There are models within U.S. fishery management that could be applied to engagement for offshore wind.

How BOEM will use this information

- Improve engagement with the fishing community
- Establish a regional monitoring program

Additional information

Workshop report: www.nap.edu/read/25062/chapter/1


What's Next?

Here are a few of the new and continuing studies that are underway:

Mapping the seafloor is expensive and time consuming, and very little of the areas where wind development may occur is mapped in detail. Often, models are used to fill in the gaps. BOEM is funding a project with the National Oceanic and Atmospheric Administration to **enhance seafloor modeling** through detailed data collection and improving the predictive models currently in use.
[Expected completion: 2019]

For several years, BOEM has been funding **acoustic monitoring in both the Virginia and Maryland** Wind Energy Areas. These monitors record the sounds made by whales, particularly the North Atlantic right whale, as they migrate along the coast. The monitoring stations are part of a larger network to expand our understanding of **whale migration** from Nova Scotia to Florida.
[Expected completion: 2019]

During the construction of the first U.S. offshore wind farm near Block Island, RI, researchers were in the field making **observations about the turbine construction and early operation activities**, including the sound levels produced in air and underwater, seafloor disturbance, and activity duration. The results will be used to improve model predictions and refine assessments of the environmental effects.
[Expected completion: 2019]