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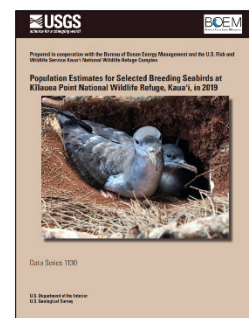
Biological Studies

Ongoing (2017-2022) — Atlas of Main Hawaiian Island Seabird Colonies

This study by the U.S. Geological Survey is developing a comprehensive up-to-date atlas of Hawaiian seabird colonies. It will be used to evaluate threats to colonies and adjacent high-use offshore waters, provide a reference to measure population trends, and best inform place-based conservation and restoration actions.

Study Profile: <https://www.boem.gov/pc-17-03/>

USGS Report and Data Release: <https://pubs.er.usgs.gov/publication/ds1130>

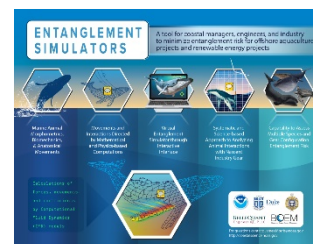


Ongoing (2019–2022) — Development of Computer Simulations to Assess Entanglement Risk to Whales and Leatherback Sea Turtles in Offshore Floating Wind Turbine Moorings, Cables, and Associated Derelict Fishing Gear Offshore California

This study, in partnership with the National Oceanic and Atmospheric Administration's National Centers for Coastal Ocean Science, has developed morphologically and behaviorally accurate 3-D computer models of protected whale species (fin and humpback) and leatherback sea turtles. Two offshore floating wind mooring systems are currently under digital development. The whale and mooring system models will be integrated into simulations to visualize various potential interaction scenarios, including considering associated derelict fishing gear. These simulations will assist BOEM in assessing the risk and potential severity of entanglement, and potentially identify mitigation measures to reduce any risk.

Study Profile: <https://www.boem.gov/pr-19-ent-profile/>

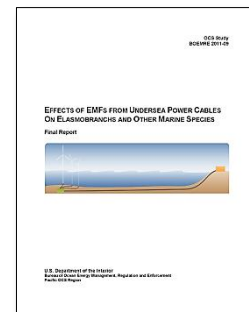
Infographic: <https://www.boem.gov/PR-19-ENT-Infographic>



Completed (2011) — Effects of EMF from Undersea Power Cables on Elasmobranchs and Other Marine Species

This study by Normandeau Associates synthesized data and information about subsea power-transmission cables and the sensitivity of marine organisms to electromagnetic fields (EMF) produced by the cables. It produced a database of information about potentially affected species of elasmobranchs (sharks and rays), other fishes, marine mammals, sea turtles, and invertebrates. It also recommended future research priorities and potential mitigation measures.

Report (BOEMRE 2011-09): <https://espis.boem.gov/final%20reports/5115.pdf>

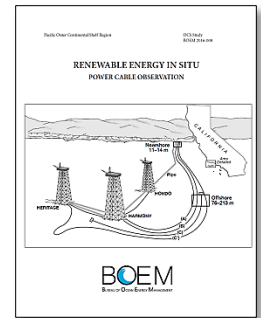


Completed (2016) — Renewable Energy *in situ* Power Cable Observation

This study by the University of California, Santa Barbara measured the strength and variability of electromagnetic fields (EMF) along subsea power transmission cables in the Santa Barbara Channel, which are similar to cables used for offshore renewable energy inter-device electrical connections. It also compared fish communities in cable versus natural habitats and determined the potential effectiveness of cable burial as a mitigation measure to decrease EMF.

Report (BOEM 2016-008): <https://espis.boem.gov/final%20reports/5520.pdf>

Webinar: <https://www.boem.gov/Science-Exchange-3/>



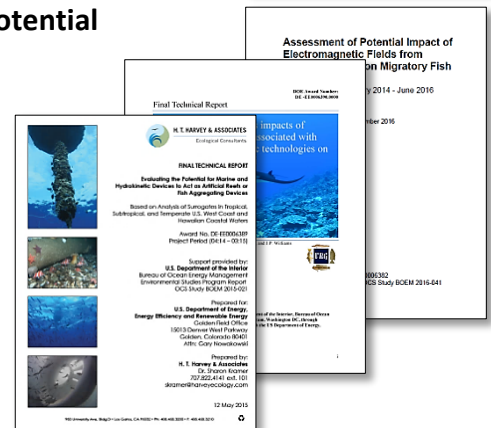
Completed (2016) — Using Ongoing Activities as Surrogates to Predict Potential Ecological Impacts from Marine Renewable Energy

BOEM and the U.S. Department of Energy partnered on this study to identify and analyze data from ongoing projects and activities (surrogates) with stressors and receptors similar to those expected from marine renewable energy projects. Two reports examined potential impacts of electromagnetic fields from operating power cables, and one examined mooring configurations of offshore surrogates such as aquaculture facilities and oceanographic buoys as fish attracting devices.

First Report (BOEM 2015-021): <https://www.boem.gov/2015-021/>

Second Report (BOEM 2015-042): <https://www.boem.gov/2015-042/>

Third Report (BOEM 2016-041): <https://www.boem.gov/2016-041/>



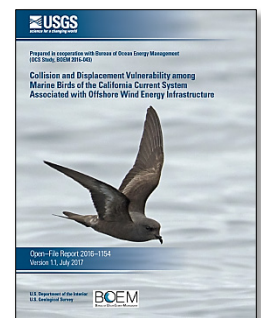
Completed (2016) — Developing and Applying a Vulnerability Index for Scaling the Possible Adverse Effects of Offshore Renewable Energy Projects on Seabirds on the Pacific OCS

This BOEM-directed study, conducted and primarily funded by the U.S. Geological Survey, developed a comprehensive database to evaluate 81 marine bird species in the California Current System (CCS) in terms of their collision and displacement vulnerability from offshore wind energy infrastructure. It used existing and newly analyzed at-sea behavioral information (e.g., avian habits and activities, flight-height, and flight characteristics) and population metrics to identify species-specific vulnerabilities at the population level. The vulnerability assessment results can now be combined with recent marine bird at-sea distribution and abundance data for the CCS to help address seabird conservation during the siting and operation of offshore wind energy development projects.

Report (USGS OFR 2016-1154, BOEM 2016-043):

<https://pubs.er.usgs.gov/publication/ofr20161154>

Webinar: <https://www.boem.gov/Science-Exchange-6/>

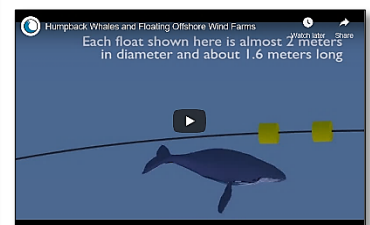
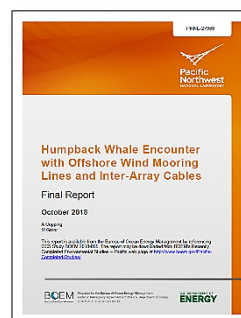


Completed (2018) — Humpback Whale Encounter with Offshore Wind Mooring Lines and Inter-Array Cables

This study by the U.S. Department of Energy/Pacific Northwest National Laboratory compiled information about whale movements (e.g., dive depths and swimming speed) and created a three-dimensional video animation of how whales may move through a hypothetical offshore floating wind farm. This visual simulation will help characterize the risk of whale encounters with mooring lines and electrical cables used in offshore floating wind projects.

Report (BOEM 2018-065): <https://www.boem.gov/BOEM-2018-065/>

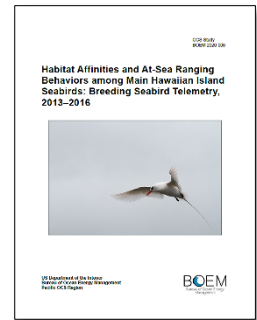
Video Animation: <https://www.boem.gov/Humpback-Whales-Floating-Wind/>



Completed (2020) — Habitat Affinities and At-sea Ranging Behaviors among Main Hawaiian Island Seabirds

This study by the U.S. Geological Survey conducted field studies of at-sea habitat utilization and ranging behaviors for seabirds breeding within the main Hawaiian Islands. It also compiled and analyzed remotely sensed and modeled habitat data to examine habitat relationships to predict species' distributions and improve spatial vulnerability maps. Results will be used by BOEM to assess potential effects of offshore renewable energy development to main Hawaiian Island seabirds.

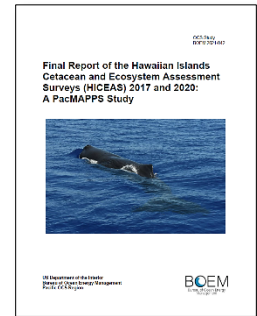
Report (BOEM 2020-006): https://espis.boem.gov/final%20reports/BOEM_2020-006.pdf



Completed (2021) — Pacific Marine Assessment Partnership for Protected Species (PacMAPPS) – Hawaiian Archipelago

This study was a partnership between BOEM, the National Marine Fisheries Service, and the U.S. Navy to conduct shipboard surveys of marine mammals, seabirds, and, to the extent possible, sea turtles in the Pacific. The data collected during 2017 and 2020 (winter) surveys of the Hawaiian Islands will help BOEM evaluate potential effects of proposed renewable energy activities on protected species, that includes an ecosystem-level context.

Report (BOEM 2021-042): https://espis.boem.gov/final%20reports/BOEM_2021-042.pdf



Cultural & Archaeological Studies

Completed (2017) — Maritime Cultural Resources Site Assessment in the Main Hawaiian Islands

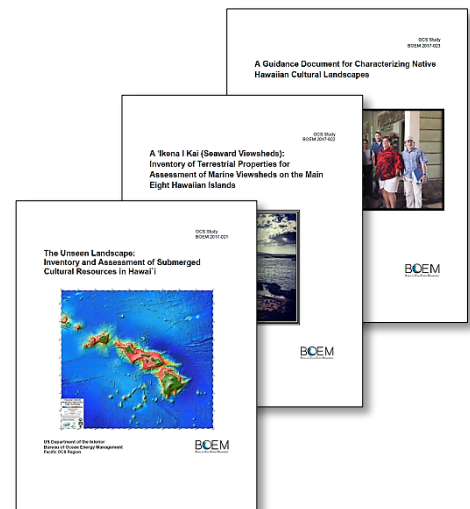
This study assessed maritime cultural resources in Hawaii and was a collaborative effort between BOEM, the National Oceanic and Atmospheric Administration, a Native Hawaiian project facilitator, and an inter-island consultative working group made up of representatives from the main Hawaiian Islands. The study developed an inventory of submerged cultural resources on the Hawaii OCS, an inventory of terrestrial historic properties on the eight main Hawaiian Islands that could be within view of offshore renewable energy sites, and a best-practices tool for characterizing Native Hawaiian cultural landscapes. The overarching goal of this effort was to help facilitate federal decision-making processes in support of offshore renewable energy development.

Study Fact Sheet: <https://www.boem.gov/PC-13-01-Fact-Sheet/>

First Report (BOEM 2017-021): <https://www.boem.gov/BOEM-2017-021/>

Second Report (BOEM 2017-022): <https://www.boem.gov/BOEM-2017-022/>

Third Report (BOEM 2017-023): <https://www.boem.gov/BOEM-2017-023/>



Information Synthesis Studies

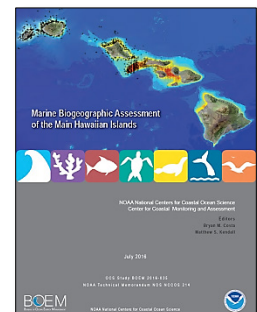
Completed (2016) — Marine Biogeographic Assessment of the Main Hawaiian Islands

This study by the National Oceanic and Atmospheric Administration, working with Hawaiian partners, assembled and synthesized information about physical and biological resources offshore the main Hawaiian Islands, including physical oceanography, bathymetry, marine mammals, seabirds, sea turtles, fish, and corals. The assessment will help to characterize the distribution and abundance of marine resources in state and federal waters, identify knowledge gaps, support spatial planning for development of offshore renewable energy, and contribute to ecosystem-based management of marine resources.

Project Details: <https://coastalscience.noaa.gov/project/marine-biogeographic-assessment-hawaiian-islands/>

Data Products: <https://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:155189>

Report (BOEM 2016-035): <https://espis.boem.gov/final%20reports/5555.pdf>



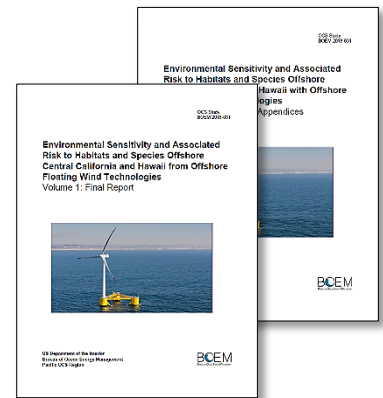
Completed (2018) — Environmental Sensitivity and Associated Risk to Habitats and Species Offshore Central California and Hawaii from Offshore Floating Wind Technologies

This study by ICF International identified and characterized potential impact-causing factors to the marine environment related to offshore floating wind energy development. The study developed an environmental sensitivity and relative risk model to assess impacts on biological and habitat resources from offshore floating wind technology.

Report (BOEM 2018-031):

Volume 1: https://espis.boem.gov/final%20reports/BOEM_2018-031.pdf

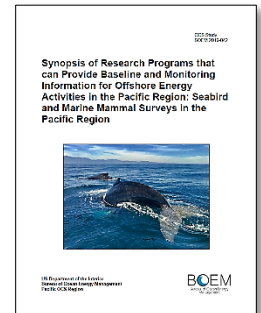
Volume 2: https://espis.boem.gov/final%20reports/BOEM_2018-031_A.pdf



Completed (2019) — Synopsis of Research Programs that can Provide Baseline and Monitoring Information for Offshore Energy Activities in the Pacific Region

This study by the U.S. Geological Survey identified research programs that have produced databases containing information on species and habitats sensitive to offshore energy activities in the Pacific Region. It evaluated the capability of these programs to provide baseline and monitoring data to understand and mitigate potential impacts of conventional energy development offshore southern California and renewable energy development offshore southern California, Oregon, Washington, and Hawaii.

Report (BOEM 2019-042): <https://www.boem.gov/2019-042/>

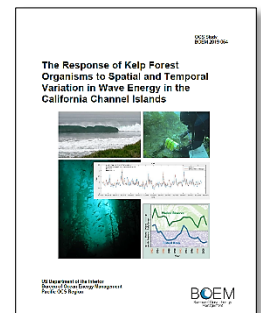


Physical Oceanography & Geology Studies

Completed (2019) — Predicting the Consequences of Wave Energy Absorption from Marine Renewable Energy Facilities on Nearshore Ecosystems

By calibrating a regional wave model with site-specific wave measurements and site-specific biological data (30+ year time series from the National Park Service and the U.S. Geological Survey offshore southern California), this study developed a statistical model to predict the potential effects of wave energy absorption from marine renewable energy facilities on nearshore ecosystems, especially giant kelp forests. The study found that wave energy had a significant effect on several species. But for most taxa (36/57), density was unrelated to waves. Even for those species with a statistical relationship between density and wave energy, a 15% reduction in wave height would not have a detectable effect on the density of any species.

Report (BOEM 2019-064): https://espis.boem.gov/final%20reports/BOEM_2019-064.pdf

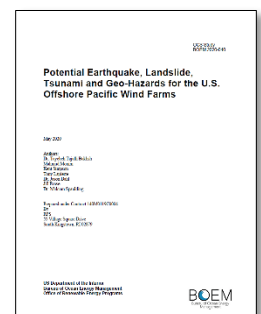


Completed (2020) — Potential Earthquake, Landslide, Tsunami and Geo-Hazards on the U.S. Offshore Pacific Wind Farms

Floating offshore wind (FOW) construction and operation on the U.S. West Coast may face the risk of potential geohazards, as they are relatively new applications of older technologies (land-based wind and mobile offshore drilling units) in tectonically active regions. Seismic activities, landslides, and tsunamigenic earthquakes are threats to the U.S. West Coast and Hawaii, and uncertainty exists over how FOW development and siting will be impacted by these threats in proposed areas of development. This study provided both a general evaluation of geohazards for floating wind areas already designated as potential lease sites and developed design considerations and criteria for structures to cope with extreme events.

Report (BOEM 2020-040): <https://www.boem.gov/environment/final-report-geohazards>

Web Map Interface: <http://boem-oceansmap.s3-website-us-east-1.amazonaws.com/>

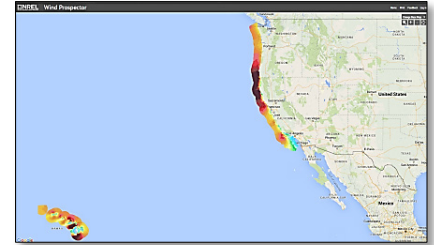


Resource, Technology & Infrastructure Studies

Completed (2015) — Pacific Offshore Time Series Wind Resource Analysis

This study by the U.S. Department of Energy/National Renewable Energy Laboratory (NREL) addressed time-series analysis of wind speed data along the coasts of Washington, Oregon, California, and Hawaii, scaled to BOEM's aliquot grid (a unit of leasing). Average wind speed is provided by month, by hours of the day, and for a long-term (17-year) time series. Data are available through Wind Prospector, NREL's web-based GIS application, which provides easy access to wind resource datasets and supports resource assessment and exploration associated with wind development.

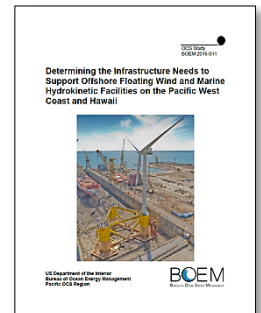
Data: <https://maps.nrel.gov/wind-prospector/>



Completed (2016) — Determining the Infrastructure Needs to Support Offshore Floating Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii

This study by ICF International evaluated the current infrastructure and vessel requirements and capabilities existing on the Pacific West Coast of the U.S. and the Hawaiian islands of Oahu, Maui, and Kauai to support the burgeoning offshore renewable energy industry. Understanding the infrastructure needs of the offshore renewable industry will help to identify the port-related requirements for offshore floating wind development and marine hydrokinetic industries and assess the utilization of the available marine equipment and facilities along the U.S. West Coast.

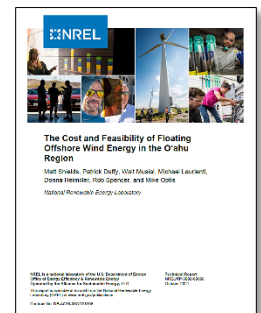
Report (BOEM 2016-011): <https://espis.boem.gov/final%20reports/5503.pdf>



Completed (2021) — The Cost and Feasibility of Floating Offshore Wind Energy in the O'ahu Region

This study by the U.S. Department of Energy/National Renewable Energy Laboratory (NREL) evaluated the costs of floating offshore wind in the region surrounding O'ahu and provided data visualization to inform Hawaii's energy planning process. NREL used the most up-to-date floating offshore wind technology information, cost model input assumptions for the unique Hawaii market, and the Offshore Regional Cost Analyzer model to evaluate floating offshore wind costs on a levelized cost of energy (LCOE) basis. The study also compiled preliminary feedback and information from local stakeholders on the benefits and drawbacks of offshore wind and suggested future studies and activities to help inform decision makers about offshore wind in the region.

Report (BOEM 2021-070): <https://www.boem.gov/BOEM-2021-070>



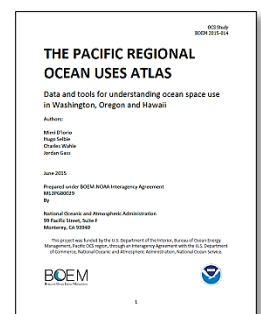
Socioeconomic Studies

Completed (2015) — Pacific Regional Ocean Uses Atlas

This partnership between BOEM and the National Oceanic and Atmospheric Administration documented patterns of existing and emerging ocean uses in OCS areas off the states of Washington, Oregon, and Hawaii through participatory mapping workshops. The project also identified potential areas of conflict and/or compatibility between proposed renewable energy areas and other ocean uses. The atlas documents a full range of human activities and sectors in the ocean to support offshore renewable energy planning.

Report (BOEM 2015-014): <https://www.boem.gov/2015-014/>

Project Information: <https://marinecadastre.gov/oceanuses/>

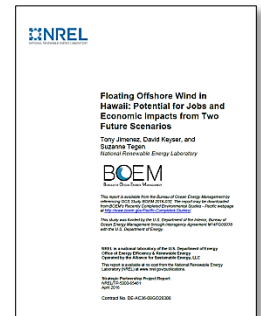


Completed (2016) — Floating Offshore Wind in Hawaii: Potential for Jobs and Economic Impacts from Two Future Scenarios

This study by the U.S. Department of Energy/National Renewable Energy Laboratory conducted an analysis of the employment and economic potential for floating offshore wind in Hawaii. The study examined two scenarios: 400 MW of offshore wind installed by 2050 and 800 MW of offshore wind installed by 2050. The results of this analysis can be used to better understand the general scales of economic opportunities that could result from offshore wind development.

Report (BOEM 2016-032): <https://www.boem.gov/2016-032/>

Jobs and Economic Development Impact Wind Models Website: <https://www.nrel.gov/analysis/jedi/wind.html>



Other Studies Informing OCS Renewable Energy (not specific to Hawaii)

- BOEM 2013-0116 Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments**
(<https://espis.boem.gov/final%20reports/5298.pdf>)
- BOEM 2016-002 Development of Guidance for Lighting of Offshore Wind Turbines Beyond 12 Nautical Miles**
(<https://www.boem.gov/offshore-lighting-guidance/>)
- BOEM 2017-057 Phased Approaches to Offshore Wind Development and Use of the Project Design Envelope**
(<https://www.boem.gov/Phased-Approaches-to-Offshore-Wind-Developments-and-Use-of-Project-Design-Envelope/>)
- BOEM 2018-053 Impact Assessment and Mitigation of Offshore Wind Turbines on High Frequency Coastal Oceanographic Radar** (https://espis.boem.gov/final%20reports/BOEM_2018-053.pdf)
- BOEM 2018-057 Metocean Characterization Recommended Practices for U.S. Offshore Wind Energy**
(<https://www.boem.gov/Metocean-Recommended-Practices/>)
- BOEM 2020-039 Radar Interference Analysis for Renewable Energy Facilities on the Atlantic Outer Continental Shelf**
(<https://www.boem.gov/environment/radar-interference-atlantic-offshore-wind0pdf>)
- BOEM 2021-030 Floating Offshore Wind Turbine Development Assessment** (<https://www.boem.gov/renewable-energy/studies/study-number-deliverable-4-final-report-technical-summary>)
- BOEM 2021-032 Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States**
(<https://www.boem.gov/environment/environmental-studies/boem-2021-032>)
- BOEM 2021-053 Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations**
(<https://www.boem.gov/environment/wind-turbine-foundations-white-paper-final-white-paper>)

For more information about BOEM-funded research:

Environmental Studies Program: <https://www.boem.gov/Studies/>

Pacific OCS Environmental Studies: <https://www.boem.gov/Pacific-Studies/>

Environmental Studies Program Information System (ESPIS): <https://marinecadastre.gov/espis/#/>

Renewable Energy Research: <https://www.boem.gov/environment/environmental-studies/renewable-energy-research>

BOEM Activities in Hawaii: <https://www.boem.gov/Hawaii>

