Quarterly Reports

FY 2021 Fourth Quarter

Latest Reports and Study Profiles Posted to the Environmental Studies Program Information System (ESPIS)

BOEM
Bureau of Ocean Energy Management

Contents

The Environmental Studies Program (ESP) Quarterly Reports include summaries of the Bureau of Ocean Energy Management (BOEM) environmental studies completed each quarter. These studies inform BOEM's policy decisions on the development of energy and mineral resources on the Outer Continental Shelf (OCS).

Visit ESPIS at *https://marinecadastre.gov/espis*

List of Studies

Measuring Wave Forces Along Alaska's Coastal Sea Ice

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100133*

Conducted by: **University of Alaska Fairbanks**

National Studies List: AT-17-x10

Study Products (available in ESPIS): Final report, technical summary, related publications

Programmed to collect data on "extreme" ice events, the IWR5 ICEX2020 looks toward Camp Seadragon

Purpose/Information Use:

The duration of open water operations in the Chukchi and Beaufort seas is likely to increase due to the expected lengthening of the melt season, declining ice extent, and thinning ice. These trends may increase exposure of the Arctic Ocean to surface winds and increased fetch (how far waves travel), which may increase wind-generated waves that overtake slush and brash ice, affect floe size and strength, and influence landfast ice at the Arctic periphery. Landfast ice is used as a platform for subsistence hunting and potentially for wintertime activities related to oil and gas exploration and development in the Beaufort and Chukchi seas. A primary goal of this study was to develop and deploy sensors to provide early warnings about important ice events to alert forecasters and ice users about specific ice conditions and hazards. BOEM will use the information from this study to better understand the mechanical properties of sea ice within the landfast ice zone and the stresses that cause breakout events (detachment of shore-fast ice).

Findings/Results:

- The data show the ice to be relatively motionless, occasionally punctuated by short bursts of large accelerations (jolts), possibly due to ice-on-ice collisions, and longer-lasting signals (rumbles), possibly from ice grinding or ridge formation.
- The study measured jolts up to 20 meters per second (m s^{-2}). A jolt of 10 m s^{-2} occurred prior to a nearby detachment and breakout of ice that then drifted into the Beaufort Sea.
- Based on data gathered so far, there is no definitive threshold for accelerations that lead to a breakout event.

Final Report:

Johnson MA, Mahoney AR. 2021. Measuring wave forces along Alaska's coastal sea ice. Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management. 70 p. Report No.: OCS Study BOEM 2021-019.

High-frequency Characterization of the Physicochemical Parameters of Cook Inlet, Alaska

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100201*
Conducted by: **University of Alaska Fairbanks (UAF)**
National Studies List: AK-13-03-23
Study Products (available in ESPIS): Final report, technical summary, related publication

UAF student Noah Khalsa filling sample bottles with recently collected reference seawater

Purpose/Information Use:

More information is needed about how ocean acidification (OA), a decrease in ocean pH caused by the absorption of carbon dioxide, affects the nearshore environment. Nearshore ecosystems help to protect the coastline and provide important habitats for marine animals. Because these ecosystems are highly dynamic and complex, it has been challenging to accurately monitor ocean chemistry changes in coastal waters, especially along Alaska's vast coastlines. Evidence suggests that OA threatens marine species vital to Alaska's fisheries, thus creating concerns among policymakers and managers in the state regarding this challenge. The goal of this study was to deploy oceanographic sensors at two study sites in Kachemak Bay to improve our understanding of nearshore carbonate chemistry, which can inform biological studies investigating aspects of OA tolerance and local adaptation in Alaska. BOEM will use the results of the study to inform analysis of cumulative effects related to energy development in the Cook Inlet.

Findings/Results:

- The results of this study did not support the hypothesis that changes in the amount of freshwater flowing into Kachemak Bay would alter the pH dynamics in the bay. Instead, the strongest drivers of pH dynamics were tidal oscillation, followed by biological activity.
- Seasonal patterns also dominated, as winter and summer dynamics differed considerably. Mass water movement was detected in winter at both study sites but less so during summer.

Final Report:

Kelley A. 2021. High-frequency characterization of the physicochemical parameters of Cook Inlet, Alaska. Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management. 16 p. Report No.: OCS Study BOEM 2021-018.

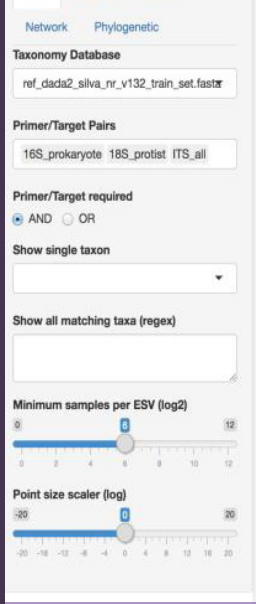
Initiating an Arctic Marine Biodiversity Observing Network (AMBON) for Ecosystem Monitoring

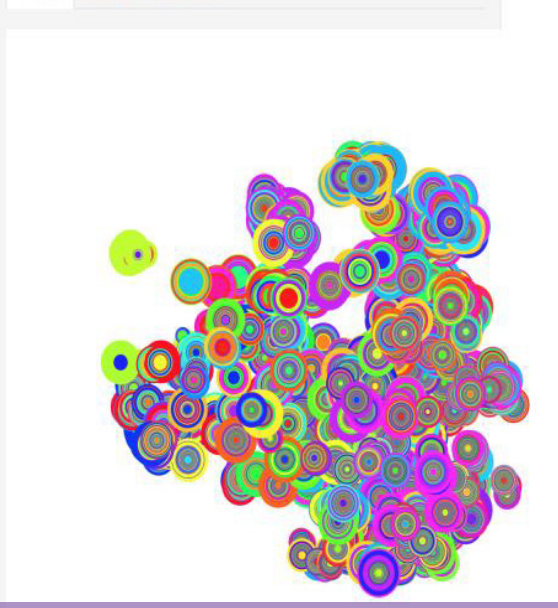
ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100075*

Conducted by: **NOAA Integrated Ocean Observations Systems; University of Alaska Fairbanks**

National Studies List: AK-15-01

Study Products (available in ESPIS): Final report





Microscape of microbes collected during the AMBON cruises, positioned based on DNA similarity

Purpose/Information Use:

The goal of the AMBON project was to build an operational marine biodiversity observation network for the U.S. Chukchi Sea continental shelf as a prototype network for the nation. The importance of the Arctic Ocean to global climate and ecosystem processes, and the speed at which climate changes are already occurring in the Arctic, elevate the urgency for coordinated observations of Arctic marine biodiversity. In a system with extremely high seasonal and interannual variability, only long-term datasets can provide the basis to distinguish changes driven by climate changes or anthropogenic impacts from those created by natural variability and regular cycles. Biodiversity measures for the marine environment need to be acquired through systematic and comprehensive methodology. Through AMBON's rigorous monitoring system, BOEM will obtain improved information about the health of biodiversity in the Chukchi Sea in order to enhance environmental impact assessments and develop better metrics for cumulative impact analysis.

Findings/Results:

- AMBON provided important Arctic biodiversity information in the Chukchi Sea across multiple ecosystem components, from microbes to whales.
- AMBON collections extended observations of ecosystem elements that are not currently sampled through other programs, e.g., microbial diversity, functional diversity (the range of things that organisms do), and trophic diversity (the diversity of the diet of a predator species).
- AMBON's sampling methods were used to evaluate the strengths and weaknesses of reduced sampling designs that could be more time- or cost-efficient to support a sustainable Arctic observing design.

Final Report:

Danielson S, Hopcroft R, Mueter F, Grebmeier J, Cooper L, Stafford K, Bluhm B, Kuletz K, Moore S. 2021. Initiating an Arctic Marine Biodiversity Observing Network (AMBON). Anchorage (AK): U.S. Department of the Interior, Bureau of Ocean Energy Management. 59 p. Report No.: OCS Study BOEM 2021-017.

Oil Spill Effects Literature Synthesis: Crude Oil, Diesel, and Condensate Spills 500–20,000 bbl

Photograph of an oil spill, taken with a multispectral camera

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100260*
Conducted by: **Research Planning, Inc.**
National Studies List: AK-19-08
Study Products (available in ESPIS): Final report, technical summary

Purpose/Information Use:

When conducting National Environmental Policy Act (NEPA) assessments, BOEM uses information about the general effects of oil spills, spill volume, spill type, duration, and location to estimate impacts to resources. However, many of the well-studied oil spills (e.g., Exxon Valdez and Deepwater Horizon) are orders of magnitude larger than the average Outer Continental Shelf oil spill used for NEPA impact assessments. Much of the information regarding smaller spills of 500–20,000 barrels (bbl) is spread throughout the gray literature or conference proceedings and is not easily accessible to BOEM's NEPA analysts. The goal of this study was to synthesize available oil spill research (from 1964–2020) for a range of spill sizes and three oil types. The results of the study will enable BOEM to better meet its responsibilities of managing offshore energy while considering the potential impacts of oil spills in an efficient and holistic manner.

Findings/Results:

- There are few spills of 500–20,000 bbl with adequate information for assessing impacts to marine resources, and even fewer spills where full recovery was documented.
- The degree and duration of impacts varied widely among resources, with the shortest for air and water quality and commercial or recreational fishing, and the longest for resources that have a longer life history (e.g., mangrove forests, which can take decades to reach maturity after disturbance).
- Very few of the spills included in this analysis had any studies on socio-economic resources other than recreation and tourism.
- Rigorous field study designs should be prepared and readied for implementation in the event of a substantial spill.

Final Report:

Michel J, editor. 2021. Oil spill effects literature study of spills of 500–20,000 barrels of crude oil, condensate, or diesel. Anchorage, AK: U.S. Department of the Interior, Bureau of Ocean Energy Management. 216 p. Report No.: OCS Study BOEM 2021-048.

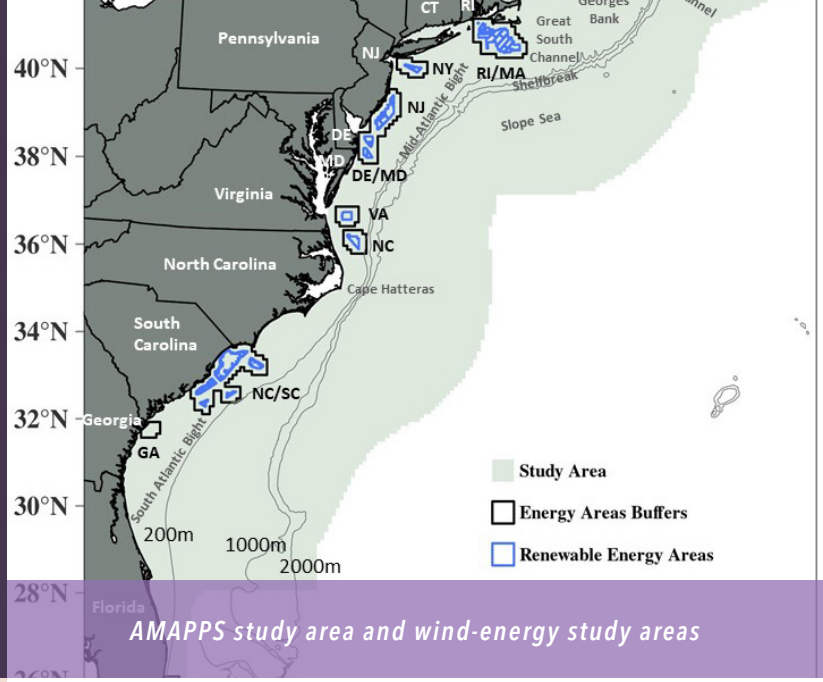
Atlantic Marine Assessment Program for Protected Species (AMAPPS II)

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100066*

Conducted by: **NOAA Fisheries**

National Studies List: AT-14-03

Study Products (available in ESPIS): Final report, technical summary, related publications, data products



AMAPPS study area and wind-energy study areas

Purpose/Information Use:

AMAPPS is a comprehensive multi-agency research program to assess the abundance, distribution, ecology, and behavior of marine mammals, sea turtles, and seabirds throughout the U.S. Atlantic outer continental shelf and to evaluate these data within an ecosystem context. Researchers used a range of tools to collect visual, passive acoustic (listening to sounds animals make), and telemetry (tagging and tracking animals) data on protected species. Active acoustics (putting sound in the water and listening for the return signal) and net tows, together with photographic and satellite imagery, were used to sample other trophic levels (e.g., fish, plankton). The study built upon previous efforts and provided BOEM with an updated range of cetacean assessments and distributions from Maine to the Florida Keys, new insights into how protected species use the water column, and a better understanding of what physical and biological characteristics are associated with these species. BOEM will use these data to inform decisions regarding offshore wind and marine mineral development in the Atlantic region.

Findings/Results:

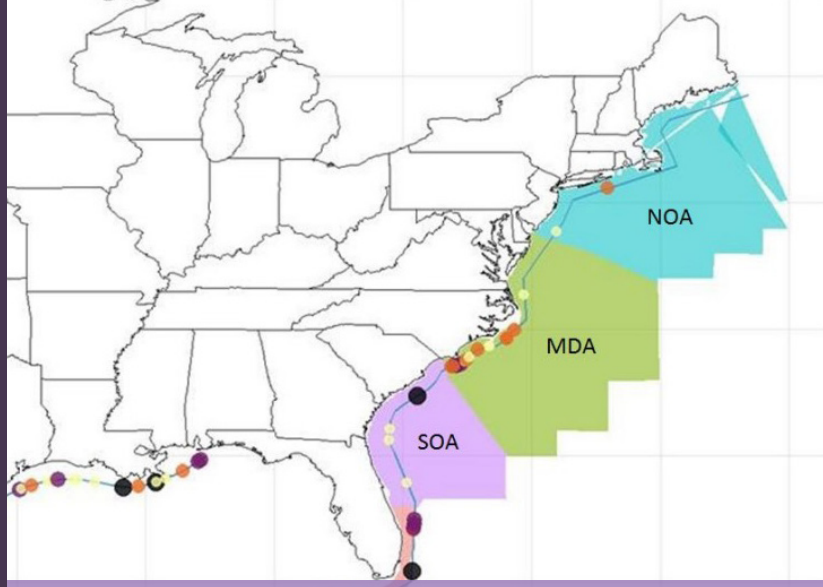
- The analyses illustrated declines in the number of coastal bottlenose dolphins, sei whales, and harbor porpoises; increases in the number of long-finned pilot whales; and geographic shifts of humpback whales, fin whales, Atlantic white-sided dolphins, and common dolphins.
- The passive acoustic data improved our knowledge of spatiotemporal (where and when) distributions of baleen whales and cryptic deep divers (e.g., beaked, sperm, pygmy sperm, and dwarf sperm whales).
- More loggerhead turtles use the Mid-Atlantic waters than was previously thought. In addition, study results suggest that loggerheads frequently dive into cold, highly stratified portions of the water column, colder than was previously assumed.
- AMAPPS II expanded our understanding of the distribution of plankton and the mid-water column community off shelf waters (especially with the discovery of spawning Atlantic bluefin tuna) and how the distributions of all these prey species relate to protected species.

Final Report:

Palka D, Aichinger Dias L, Broughton E, Chavez-Rosales S, Cholewiak D, Davis G, DeAngelis A, Garrison L, Haas H, Hatch J, et al. 2021. Atlantic Marine Assessment Program for Protected Species: FY15 – FY19. Washington DC: U.S. Department of the Interior, Bureau of Ocean Energy Management. 330 p. Report No.: OCS Study BOEM 2021-051.

Alternative Oil Spill Occurrence Estimators for Determining Rates for the Atlantic Outer Continental Shelf

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100250*
Conducted by: **ABSG Consulting Inc.**
National Studies List: AT-16-09
Study Products (available in ESPIS): Final report, technical summary



Map of historical hurricane occurrence in the Atlantic and Gulf of Mexico

Purpose/Information Use:

BOEM requires oil spill occurrence estimates for National Environmental Policy Act environmental analyses of hypothetical offshore oil and gas exploration and development scenarios in the Atlantic Outer Continental Shelf (OCS). Existing oil spill occurrence rates are based on historical oil spill occurrence rates from platforms, pipelines, and wells almost entirely from the Gulf of Mexico (GOM) OCS. This study developed oil spill occurrence rates for potential oil and gas activities in the U.S. Atlantic OCS planning areas and incorporated differences in oil spill causal factors between the Atlantic and GOM OCS, as well as additional Atlantic-specific factors. BOEM may apply the findings of this study to future oil and gas exploration and development in the Atlantic OCS if the Atlantic is included in national oil and gas planning programs in the future.

Findings/Results:

- The study presented updated historical spill rates for the GOM planning area for 1974–2019. This was done for the four unique operational modes involved in oil and gas activities: exploratory drilling, development drilling, development production, and pipeline operations.
- The study completed a large spill analysis that quantified extreme spill occurrence, including the same four operational modes.
- Lastly, the study developed a methodology to estimate spill occurrence rates for the Atlantic OCS. This involved specifying the causal factors behind the GOM OCS historical spills and creating adjustment factors for each oil spill causal factor for the Atlantic. The adjusted rates were then processed through the exploration and development scenarios to arrive at the projected rates for the Atlantic OCS.

Final Report:

Stalfort D, Roberts B, Culvern C. 2021. Alternative oil spill occurrence estimators for determining rates for the Atlantic Outer Continental Shelf. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 97 p. Report No.: OCS Study BOEM 2021-065.

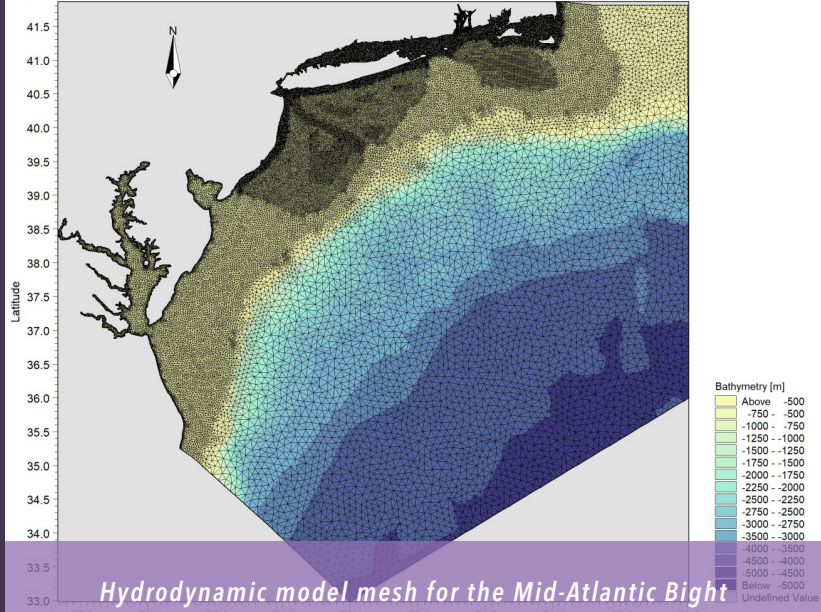
Hydrodynamic Modeling and Particle Tracking in the U.S. Mid-Atlantic Bight

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100324*

Conducted by: **DHI Water & Environment, Inc.**

National Studies List: AT-19-04

Study Products (available in ESPIS): Final report, technical summary



Hydrodynamic model mesh for the Mid-Atlantic Bight from Cape Hatteras to Cape Cod

Purpose/Information Use:

Offshore wind (OSW) facilities have the potential to alter local and regional physical oceanic processes due to the presence of structures and extraction of energy from the wind. This study used hydrodynamic modeling, particle tracking modeling, and Agent-Based Models (ABM) to assess how commercial scale offshore wind energy facilities in the Massachusetts–Rhode Island (MA-RI) marine areas may affect local and regional oceanic responses (e.g., currents, temperature stratification) and related larval transport under typical seasonal conditions. BOEM chose Atlantic sea scallops, silver hake, and summer flounder as the target species for the ABM. The researchers modeled four OSW build-out scenarios to examine how impacts might change depending on the number of turbines installed. BOEM will use the results of the study to assess changes in ocean conditions that might occur from the installation of one, or several, OSW energy facilities in the MA-RI lease area.

Findings/Results:

- The results of the study show that the introduction of turbines into the MA-RI offshore area does modify oceanic responses by reducing the current magnitude through added flow resistance, influencing the temperature stratification by introducing additional mixing, and reducing the current strength and wave height by the extraction of energy from the wind.
- These changes in currents lead to varying degrees of increases and decreases in larval settlement density across the three species and four build-out scenarios.
- At a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement, although there could be a risk of impact to certain subpopulations.

Final Reports:

Johnson TL, van Berkel JJ, Mortensen LO, Bell MA, Tiong I, Hernandez B, Snyder DB, Thomsen F, Svenstrup Petersen, O. 2021. Hydrodynamic modeling, particle tracking and agent-based modeling of larvae in the U.S. Mid-Atlantic Bight. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 232 p. Report No.: OCS Study BOEM 2021-049.

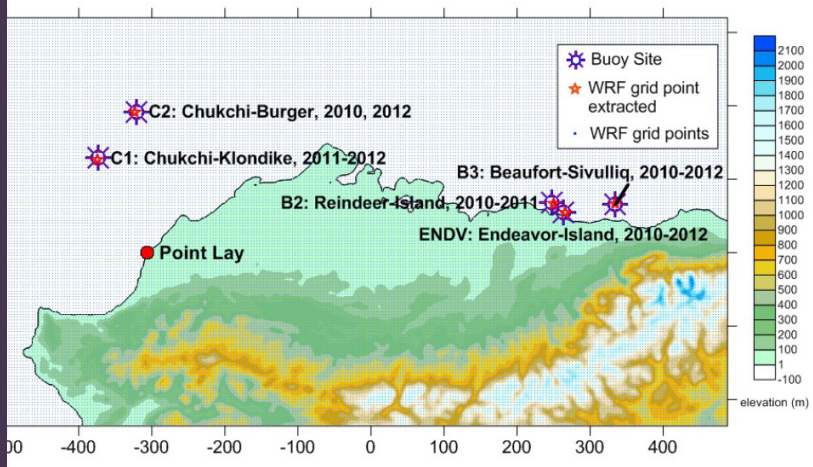
Testing and Evaluation of AERMOD Using AERCOARE and MMIF Meteorological Outputs Representative of the OCS

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/27028*

Conducted by: **Amec Foster Wheeler Environmental & Infrastructure, Inc. and Ramboll Environ US Corporation.**

National Studies List: **NT-12-04**

Study Products (available in ESPIS): Final reports, technical summary, related publications



Map of overwater meteorological measurement sites and corresponding WRF inner domain extraction points

Purpose/Information Use:

BOEM and the Environmental Protection Agency (EPA) require that air quality modeling and impact assessment be conducted for significant sources of air pollution. The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) is the preferred model used for the air quality assessment requirements of air emissions permitting. However, AERMOD's meteorological preprocessor, AERMET, was not designed to process meteorological conditions over ocean waters and more extreme climates. Currently accepted overwater dispersion modeling methods require observational datasets. These datasets are generally provided by meteorological buoys or instruments on platforms. However, the observational coverage of the oceans is sparse. The goal of this study was to assess whether output from mesoscale (medium-scale) meteorological models, such as the Weather Research and Forecasting (WRF) model, could be used to provide hourly prognostic meteorological data for AERMOD in areas where observational data are lacking. The results of the study will provide BOEM with a better understanding of the extent to which AERMOD can be used for offshore air quality assessment.

Findings/Results:

- The analyses suggest WRF was able to produce hourly meteorological datasets that compared favorably to over-water measurements.
- Furthermore, the results suggest WRF-extracted meteorology can be used as an alternative to offshore observations for air permitting in such areas.
- The results also indicate that WRF-extracted meteorology should be filtered by limits on minimum wind speed, mixing height, and other factors to avoid including extreme conditions not typically observed over water.

Final Report:

Amec Foster Wheeler Environmental & Infrastructure, Inc., Ramboll Environ US Corporation. 2015. Combined WRF/MMIF/AERCOARE/AERMOD overwater modeling approach for offshore emission sources: Vol. 1 – project report. Seattle (WA): U.S. Environmental Protection Agency Region 10. 93 p + appendices. Report No.: EPA 910-R-15-011a.

See also Vols. 2 and 3.

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

ESPIS Link: *https://marinecadastre.gov/espis/#/search/study/100120*

Conducted by: **U.S. Geological Survey (USGS); National Oceanic and Atmospheric Administration (NOAA) National Centers for Coastal Ocean Science (NCCOS)**

National Studies List: **PC-15-01**

Study Products (available in ESPIS): Final report, technical summary

Pink-footed shearwater *(Ardenna creatopus). Photo courtesy of David Pereksta.*

Purpose/Information Use:

An understanding of marine bird spatial distribution and density is important for developing offshore renewable energy resources in an environmentally sound manner. This study used a statistical modeling framework to estimate relationships between bird sighting data and a range of environmental variables that potentially affect marine birds offshore California, Oregon, and Washington. Variables include temporal (e.g., Pacific Decadal Oscillation index), spatially static (e.g., depth, slope), and spatially dynamic (e.g., sea surface chlorophyll concentration, sea surface temperature, current velocity, and wind stress). The estimated relationships were then used to predict the long-term spatial distribution of each species throughout the study region in each season. BOEM will use the results of this study to inform planning for offshore wind energy development in the Pacific region.

Findings/Results:

- The study developed maps of the predicted density for 33 species and 13 taxonomic groups of marine birds.
- The maps identify areas where the densities of marine bird species are likely to be higher or lower on a seasonal basis.
- The relative importance of each environmental predictor is also presented, which may provide a starting point for future studies addressing the ecological drivers and mechanisms behind the spatial distributions of marine birds in the study area.

Final Reports:

Leirness JB, Adams J, Ballance LT, Coyne M, Felis JJ, Joyce T, Pereksta DM, Winship AJ, Jeffrey CFG, Ainley D, et al. 2021. Modeling at-sea density of marine birds to support renewable energy planning on the Pacific Outer Continental Shelf of the contiguous United States. Camarillo (CA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 385 p. Report No.: OCS Study BOEM 2021-014.

Data available at: https://doi.org/10.25921/xqf2-r853

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Bureau of Ocean Energy Management

The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

BOEM Environmental Studies Program

The mission of the Environmental Studies Program (ESP) is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments. The proposal, selection, research, review, collaboration, production, and dissemination of each of BOEM's Environmental Studies follows the DOI Code of Scientific and Scholarly Conduct, in support of a culture of scientific and professional integrity, as set out in the DOI Departmental Manual (305 DM 3).

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