Field	Study Information
Title	Baleen Whale Behavior and Biological Sampling during Construction of Offshore Wind Farms (AT-25-03)
Administered by	Office of Renewable Energy Programs
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Procurement Type(s)	Interagency Agreement
Performance Period	FY 2025–2027
Final Report Due	TBD
Date Revised	January 8, 2024
Problem	Offshore wind (OSW) development may affect the distribution, migration, and overall health of baleen whales in the region.
Intervention	This study would leverage the existing interagency agreement with the DOE to continue baleen whale tagging, passive acoustic monitoring, co-variate environmental data collection, and analysis during offshore wind farm construction.
Comparison	The study results would be compared and validated with acoustic and visual data collected using traditional passive acoustic monitoring and ship and/or aerial surveys of baleen whale distribution and movement.
Outcome	Current data on the responses of baleen whales during offshore wind farm construction is limited to the initial construction events at two wind farms. This study would increase the current dataset to include continued construction at current and future wind farms in the study area, which could be used to assess potential environmental impacts on the species.
Context	Atlantic OCS

BOEM Information Need(s): BOEM needs to assess the impacts of Atlantic offshore wind development on marine wildlife, from the siting through operation phases, in order to guide management decisions by the Office of Renewable Energy Programs (OREP) and headquarters.

Background: BOEM has partnered with the DOE's Office of Energy Efficiency and Renewable Energy, via Interagency Agreement M21PG00011, to fund Duke University (Topic Area 1 under DOE's Funding Opportunity Announcement) that addresses marine mammal and bird monitoring in the Atlantic region. Project WOW (Wildlife and Offshore Wind - NT-21-x07) began in 2022 with a completed GAP analysis and development of an Occurrence, Exposure, Response, Consequence (OERC) framework. The first successful year of field work was completed in 2023. The current award is for five years and provides an opportunity to obtain data in project areas in Southern New England. Data collection under the current award would end in early 2025. This study would extend data collection and associated analysis for two more years, from 2025–2026. Because a large number of bird-tagging projects are planned through industry-sponsored projects, this proposal focuses on continued funding of the baleen whale monitoring

components of Project WOW including tagging, passive acoustic monitoring, co-variate data collection, and analysis.

The WOW team represents a multi-institution consortium that brings together internationally recognized principal investigators in the areas of statistical and ecological modeling (University of St. Andrews), geospatial data analysis and modeling (Duke University), marine megafauna research (Duke, Syracuse, TetraTech, Florida State, Wildlife Conservation Society [WCS], New England Aquarium), avian and bat ecology (Biodiversity Research Institute, TetraTech, SUNY Stonybrook), bioacoustics (Cornell University, Duke, Southall Environmental Associates, Syracuse University, Woods Hole Oceanographic Institution [WHOI], Pacific Northwest National Lab [PNNL]), behavioral ecology (Duke, SUNY, Syracuse, WCS), biological oceanography (Rutgers), and technology development (PNNL, WHOI, Scientific Innovations). The project team will also focus on a stakeholder engagement process organized with relevant regional entities such as the Northeast Regional Ocean Council (NROC), Mid-Atlantic Regional Council on the Ocean, Environmental-Technical Working Group, NYSERDA State of the Science Workgroups, and the Regional Wildlife Science Collaborative. Critically, the consortium has extensive experience in research, monitoring and risk assessment associated with offshore energy development, including deep relationships with wind energy developers and extensive experience collaborating with stakeholders, as well as State and Federal agencies.

Thus far, whales have been tagged during construction of the South Fork Wind and Vineyard Wind projects. Several new projects are also expected to start construction over the next couple years. This work will leverage the research and OREC completed under the existing interagency agreement and extend the tagging, passive acoustic monitoring, co-variate data collection, and analysis focused on increasing sample sizes to better understand baleen whale responses during OSW construction activities. These data will help to reduce uncertainty and will result in more robust data to inform environmental impact assessments in the region and, potentially, renewable energy development in U.S. waters more broadly.

Continued data collection would be aligned with current methods and the study area approved under the work plan approved by DOE and BOEM. Additional data would also meet the recommendations of the National Academies of Sciences, Engineering, and Medicine report (2023) on hydrodynamics and Nantucket Shoals to conduct research to better understand how North Atlantic right whales are using the habitat in this area.

Objective(s): Collect additional data to monitor baleen whale responses (behavior, movement, distribution, hormones) to OSW construction to supplement current datasets collected through Project WOW to inform impact assessments.

Methods: The proposed research will conduct continued baleen whale research during construction of offshore wind farms. Biological sampling from a research vessel outfitted with a suite of oceanographic sampling equipment, biopsy data collection, locating and tracking of whales. Biological sampling will be conducted to assess the physiology of baleen whales occurring around wind farms under construction. In particular, the effects of underwater human-generated noise have been shown to produce physiological responses in whales (i.e., elevations in stress hormones). Fecal samples will be collected opportunistically after defecation; blubber samples will be collected using remote biopsy darting; and blow samples will be collected non-invasively from targeted individual whales. Non-invasive drone technologies for blow hormone collection as used during the Vineyard Wind construction will be further utilized and developed for whale health assessments. Unmanned aerial vehicles (UAVs) (Acevedo-

Whitehouse et al. 2010; Pirotta et al. 2017) will be used to assess the body-condition of sampled large whales, which will provide insight into the nutritional status of these whales (Christiansen et al. 2020; Hirtle et al. 2022) and provide context for collected blow samples. Blow-sampling analysis of baleen whale physiological responses will be conducted to evaluate physiological responses of large whales during windfarm construction and operation.

Sound and movement archival biologging tags (e.g., Johnson et al. 2009) will be used to collect data on fine-scale individual movement and behavior simultaneously with noise exposure levels during construction. Tags have been a valuable tool to link received sound levels to behavior response in behavioral response studies (Miller et al. 2009; Tyack et al. 2011; Goldbogen et al. 2013; Southall et al. 2016; Harris et al. 2018). The tags can integrate acoustics with fine-scale movement sensors (accelerometers, magnetometers, and pressure sensors) and a GPS sensor to provide geographic position each time the whale surfaces to breathe (Mikkelsen et al. 2019; Oliveira et al. 2022). Tag deployment will be able to address potential behavioral responses of baleen whales to construction and operational activities, including displacement, changes in diving and acoustic behavior, and changes in the acoustic signal production by individual whales.

Specific Research Question(s):

1. What are the exposures and contexts in which acute behavioral responses occur in marine mammals during offshore windfarm construction?
2. How do longer-term patterns of habitat use (behavior, distribution, and abundance) change during the construction and operational periods when compared to pre-construction?
3. What are the other potential effects (e.g., avoidance, attraction, vessel collisions, and changes in stress) that could result from offshore wind construction and operation?

Current Status: N/A

Publications Completed: N/A

Affiliated WWW Sites:

WOW project web site: https://offshorewind.env.duke.edu/

DOE Press Release: https://www.energy.gov/articles/doe-announces-135-million-sustainable-development-offshore-wind

References:

Acevedo-Whitehouse K, Rocha-Gosselin A, Gendron D. 2010. A novel non-invasive tool for disease surveillance of free-ranging whales and its relevance to conservation programs. Animal conservation 13(2)217–225.

Christiansen F, Dawson SM, Durban JW, Fearnbach H, Miller C, Bejder L, Uhart M, Sironi M, Corkeron P, Rayment W, Leunissen E. 2020. Population comparison of right whale body condition reveals poor state of the North Atlantic right whale. Mar Ecol Prog Ser. 640:1–16.

Harris CM, Thomas L, Falcone EA, Hildebrand J, Houser D, Kvadsheim P, Lam FPA, Miller PJ, Moretti DJ, Read AJ, Slabbekoorn H. 2018. Marine mammals and sonar: dose-response studies, the risk-disturbance hypothesis and the role of exposure context. J Appl Ecol. 55(1):396–404.

Johnson M, de Soto NA, Madsen P. 2009. Studying the behaviour and sensory ecology of marine mammals using acoustic recording tags: a review. Mar Ecol Prog Ser. 395:55–73.

Goldbogen JA, Southall BL, DeRuiter SL, Calambokidis J, Friedlaender AS, Hazen EL, Falcone EA, Schorr GS, Douglas A, Moretti DJ, Kyburg C. 2013. Blue whales respond to simulated mid-frequency military sonar. Proc R Soc Ser B Biol Sci. 280(1765): 20130657.

Hirtle NO, Stepanuk JE, Heywood EI, Christiansen F, Thorne LH. 2022. Integrating 3D models with morphometric measurements to improve volumetric estimates in marine mammals. Methods Ecol Evol. 13(11):2478–2490.

Jensen FH, Beedholm K, Wahlberg M, Bejder L, Madsen PT. 2012. Estimated communication range and energetic cost of bottlenose dolphin whistles in a tropical habitat. J Acoust Soc Am 131(1):582–592.

Miller DA, Pacifici K, Sanderlin JS, Reich BJ. 2019. The recent past and promising future for data integration methods to estimate species' distributions. Methods Ecol Evol. 10(1):22–37.

Mikkelsen L, Johnson M, Wisniewska DM, van Neer A, Siebert U, Madsen PT, Teilmann J. 2019. Long-term sound and movement recording tags to study natural behavior and reaction to ship noise of seals. Ecol Evol. 9(5):2588–2601.

Møhl B, Wahlberg M, Heerfordt A. 2001. A large-aperture array of nonlinked receivers for acoustic positioning of biological sound sources. J Acoust Soc Am109(1):434–437.

National Academies of Sciences, Engineering, and Medicine. 2023. Potential hydrodynamic impacts of offshore wind energy on Nantucket Shoals regional ecology: an evaluation from wind to whales. Washington (DC): The National Academies Press. https://doi.org/10.17226/27154.

Oliveira C, Perez-Jorge S, Prieto R, Cascão I, Wensveen PJ, Silva MA. 2022. Exposure to whale watching vessels affects dive ascents and resting behavior in sperm whales. Front Mar Sci. 9:1–14.

Pirotta V, Smith A, Ostrowski M, Russell D, Jonsen ID, Grech A, Harcourt R. 2017. An economical custom-built drone for assessing whale health. Front Mar Sci. (4):425.

Southall BL, Nowacek DP, Miller PJ, Tyack, PL. 2016. Experimental field studies to measure behavioral responses of cetaceans to sonar. Endanger Spec Res. 31:293–315.

Spiesberger JL, Fristrup KM. 1990. Passive localization of calling animals and sensing of their acoustic environment using acoustic tomography. Am Nat. 135:107–153.

Tervo OM, Christoffersen MF, Simon M, Miller LA, Jensen FH, Parks SE, Madsen PT. 2012. High source levels and small active space of high-pitched song in bowhead whales (*Balaena mysticetus*). PLoS One. 7(12):e52072.

Tyack PL, Zimmer WM, Moretti D, Southall BL, Claridge DE, Durban JW, Clark CW, D'Amico A, DiMarzio N, Jarvis S., McCarthy E. 2011. Beaked whales respond to simulated and actual navy sonar. PloS one. 6(3):e17009.