Projecting the effects of Offshore Wind mediated benthic changes on U.S. marine ecosystems

Project Overview and Background: Marine benthic communities are highly reactive to disturbance. Changes in benthic community composition often have cascading effects, leading to broader ecosystem impacts. As Offshore Wind (OSW) development increases across the U.S., more information is needed to understand how these developments impact benthic communities and, by extension, marine ecosystems. Addressing this need, the Biodiversity Research Institute (BRI) is collaborating with researchers from Rutgers University, Duke University, the University of St. Andrews Centre for Research into Ecological and Environmental Modeling (CREEM), and the Royal Belgian Institute of Natural Sciences (RBINS).

Submerged sections of OSW structures act as artificial reefs, providing new habitat that fouling organisms, such as mussels and barnacles, can colonize. This increase in local food availability can attract an abundance of demersal fishes and some higher trophic level animals, such as seabirds and marine mammals, thus increasing biomasses within OSW areas. In this project, we will synthesize current information on OSW-mediated impacts from other oceanic regions to anticipate how benthic communities in the northwest Atlantic may respond to OSW development and project how those changes may propagate through the broader ecosystem to higher trophic level species. Using this information, we will establish a research and monitoring framework to assess changes in the northwest Atlantic in real time.

Project Goals and Objectives: Studying changes in benthic communities can be challenging, particularly due to the variation in seasonality and mobility across organisms. This project takes an ecosystem-focused approach to gain a more holistic understanding of potential impacts of OSW on marine benthic communities. The goal of this study is to synthesize existing information on benthic changes from OSW and integrate this knowledge into current OSW risk assessments, monitoring plans, and other decision making in the northwest Atlantic (Figure 1). To meet this goal, there are five major objectives:

1. *Atlantic food web model development:* Use available datasets to describe northwest Atlantic benthic food webs and their connections to higher trophic level species, creating a more holistic picture of the trophic system.
2. *Synthesize European data on benthic changes due to OSW development*: Compile studies investigating benthic habitat changes within European waters and to help identify key drivers of benthic change.
3. *Project OSW-mediated food web change*: Combining results from objectives 1 and 2, identify the most likely species to be affected by OSW in the northwest Atlantic and assess potential impacts to energy flow within the food web.

4. *Developing and testing consequence assessment frameworks*: Building on current assessment frameworks, extend OSW risk assessments for marine mammals and seabirds to include projected trophic and behavioral changes to these taxa driven by benthic change.
5. *Research plan development*: Integrating results and framework development from previous objectives, develop a benthic and ecosystem change research plan to guide future research and monitoring efforts by scientists, developers, and regulatory agencies.

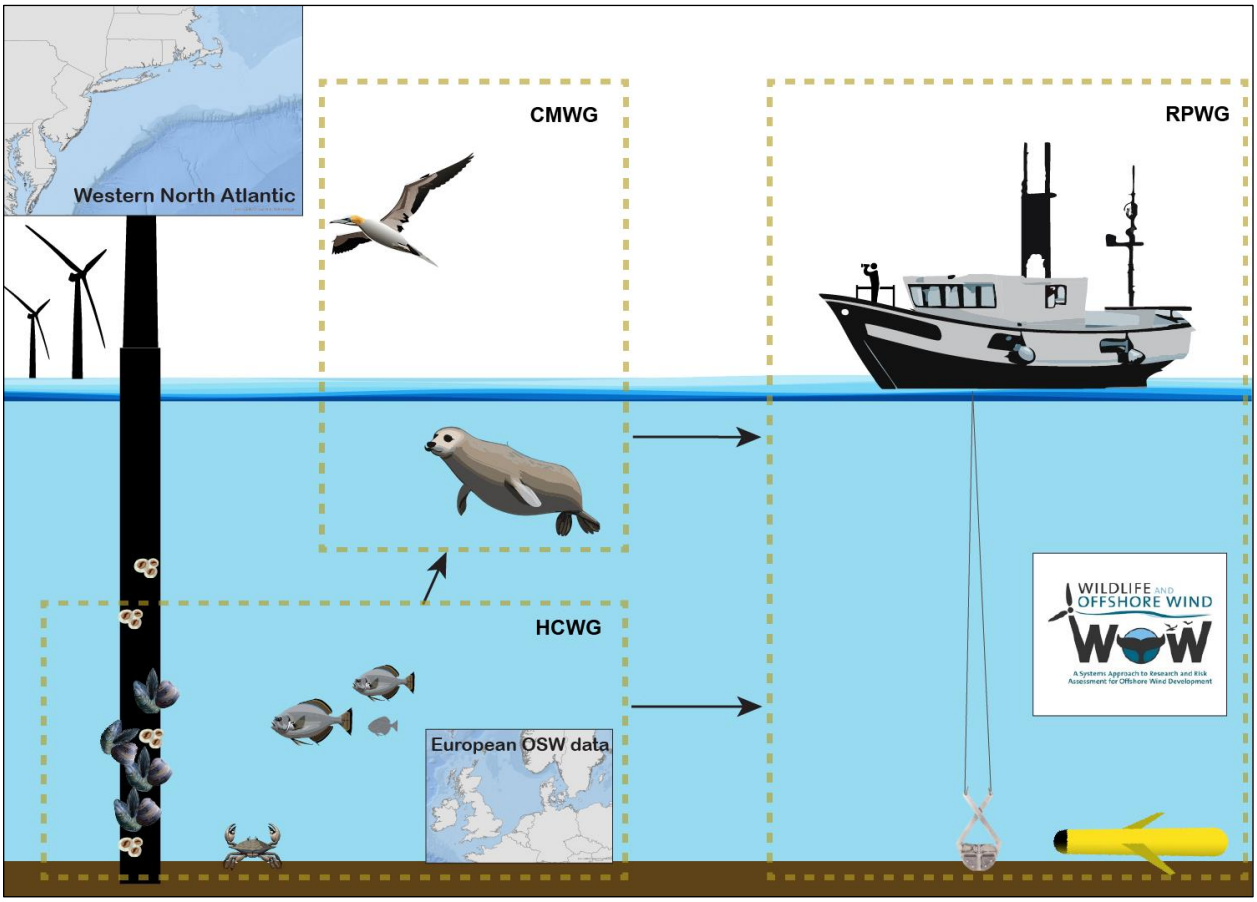

Figure 1: Offshore wind farm structures provide habitat for fouling organisms to colonize, attracting some demersal fishes, marine mammals, and seabirds to the area. Three working groups were formed to meet this project's objectives (see below for further explanation): HCWG = Habitat change working group; CMWG = Consequence modeling working group; RPWG = Research plan working group. Current information on OSW-mediated benthic change from European data (focused on the North and Baltic Seas) and monitoring efforts from Project WOW will be integrated into our analyses and research plan development.

To effectively address the five objectives above, this project has formed three major working groups (WGs) comprised of researchers from BRI and collaborating institutions:

> *1. Habitat change working group (HCWG)*: Includes collaborators from BRI, RBINS, Rutgers University, and Duke University. This group will synthesize data from the study areas, develop a conceptual food web model for the northwest Atlantic, and perform a meta-analysis to identify key drivers of benthic change, addressing objectives 1-3.
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> *2. Consequence modeling working group (CMWG)*: Includes collaborators from BRI, Duke University, and CREEM. This group will integrate projected changes in benthic prey availability into consequence models for upper trophic level predators and determine exposure risk of key species, addressing objective 4.
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> *3. Research plan working group (RPWG)*: Includes collaborators from BRI, RBINS, Rutgers University, CREEM, and Duke University. This group will integrate information from previous tasks to develop a multi-trophic level research and monitoring plan for assessing the long-term effects of benthic change on marine communities, addressing objective 5.

Study Area: Building from existing regional research, this project will assess benthic and other marine community changes in and surrounding wind lease areas in the New York Bight and off southern Massachusetts/Rhode Island (Figure 2). These highly biodiverse regions provide critical habitat for higher trophic level animals, including marine mammals and seabirds, and provide economically important fisheries resources. These study areas also overlap with two integrated regional ecosystem study (IRES) locations of Project WOW (Wildlife and Offshore Wind), a project funded by the Department of Energy and Bureau of Ocean Energy Management.

Throughout the broader region of interest, there are multiple geographic scales of inference aligning with each working group's objectives. The HCWG will assess benthic community changes within the wind farm footprints and the immediate surrounding area. The CMWG will assess consequences to higher trophic level species within a 60km radius of the wind farm footprints, as literature has shown that displacement due to OSW development can shift marine animal distributions by up to 60km. The RPWG will place findings from the other two working groups into a regional context within the Mid-Atlantic Bight and Southern New England areas, extending from Cape May, New Jersey to Cape Cod, Massachusetts.

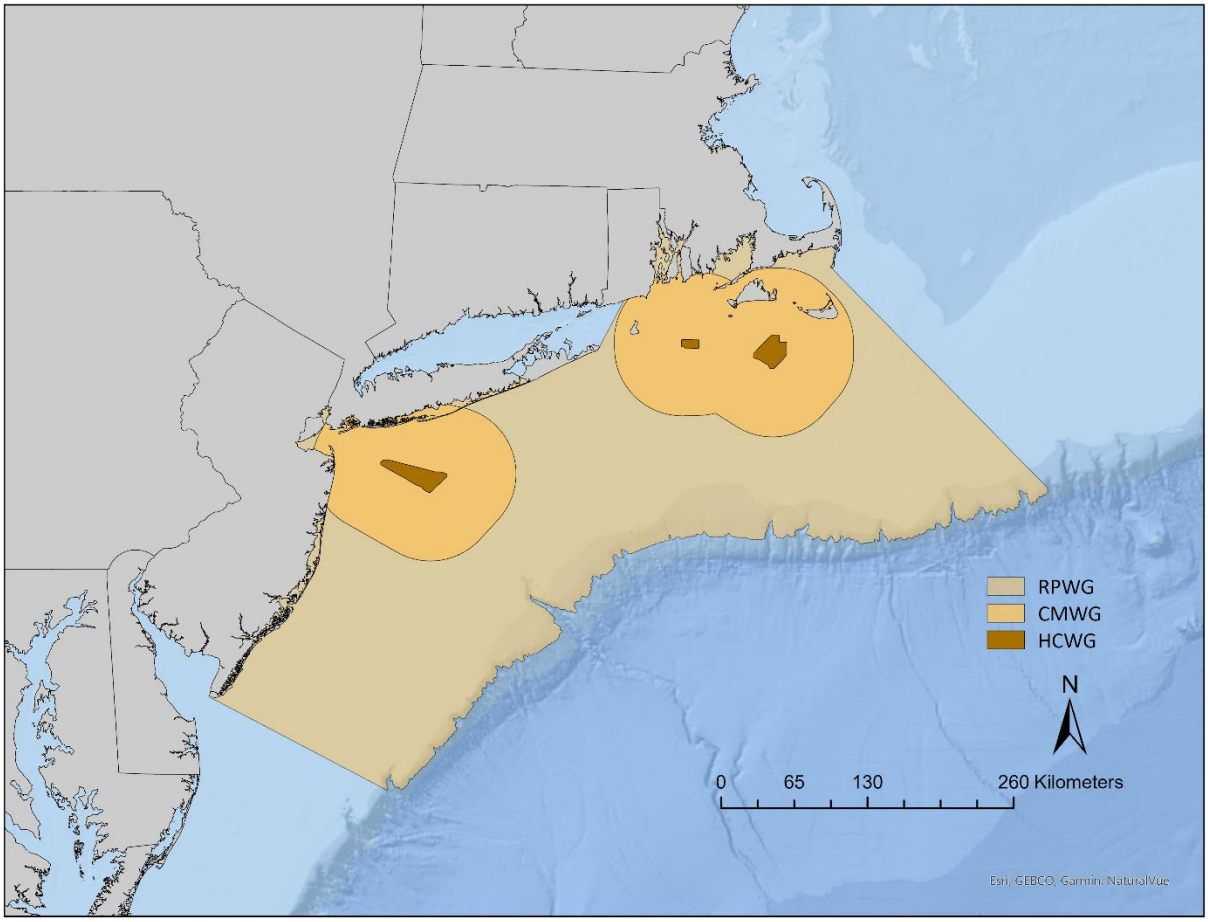

Figure 2: Study areas are off the south shore of Long Island, New York and off southern Massachusetts/Rhode Island. These areas include three OSW farms at or near completion of construction: Empire Wind (New York; far left), South Fork Wind (Massachusetts/Rhode Island; middle), and Vineyard Wind 1 (Massachusetts/Rhode Island; far right).

Benefits: This project will synthesize data products and scientific research to increase our understanding of how OSW development will impact marine communities in the northwest Atlantic. This project builds upon and works with Project WOW, a highly collaborative project assessing the effects of the first OSW developments in the eastern U.S. on marine mammals, seabirds, and other wildlife in the New York Bight and Massachusetts/Rhode Island study areas. Benthic changes can influence the behavior and distribution of these higher trophic level species and integrating knowledge of benthic communities is a critical addition to assessing ecosystem changes in this region and implementing effective research and monitoring plans.

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Project timeline: This project began in January 2024 and is anticipated to finish by December 2026.

For further information, please visit the BRI webpage: https://briwildlife.org/benthic-changes-on-us-marine-ecosystems/